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Phone +41 61 467 85 55
Fax +41 61 467 85 56
office@smw.ch

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FM 1

The blood supply of the femoral head in sheep – surgical implications for an established experimental ovine FAI model

Nadja Wolfer, Vetsuisse Faculty Zürich, Zürich/CH; Dr. Simon Damian Steppacher, Inselspital, University of Bern, Bern/CH; Prof. Dr. med. Klaus-Arno Siebenrock, Inselspital, University of Bern, Bern/CH; Dr. Katja Nuss, Vetsuisse Faculty, University of Zurich, Zürich/CH; Prof. Dr. Brigitte von Rechenberg, Vetsuisse Faculty, University of Zurich/CH; PD Dr. med. Urs Müller, Vetsuisse Faculty, University of Zurich, Bern/CH; Kathrin Süss, Vetsuisse Faculty, University of Zurich/CH; Dr. Corinne Andrea Zurmühle, Inselspital, University of Bern, Bern/CH; Till Lerch, Inselspital, University of Bern/CH; Prof. Dr. Moritz Tannast, Inselspital, University of Bern, Bern/CH

Background: Sheep hips have a natural non-spherical head similar to a cam-type deformity in human beings. By performing an intertrochanteric varus osteotomy, cam-type femoroacetabular impingement can be induced experimentally. In sheep, the aspherical portion is located superiorly – exactly matching the region where the superior retinacular vessels enter the femoral head-neck junction in human beings.
Objective: This work describes the vascular anatomy of the femoral head in sheep in order to perform safe femoral osteochondroplasty of the superior femoral asphericity in sheep.
Methods: 54 sheep hips were analyzed using CT angiography (18 hips), post mortem intravascular latex injection (6 hips), vascular corrosion casting (6 hips), and analysis of the distribution of vascular foramina around the femoral head-neck junction (24 hips). CT angiography was virtually segmented using Osirix software. The found vascular tree was used to describe the main arterial branches. The latex injection was used to describe the topographical anatomy of smaller arteries to the femoral head. The vascular corrosion casting showed the entries of the arteries into the bone. This approach allows the full description of the ovine femoral head blood supply from the aorta to the retinacular vessels.
Results: The ovine femoral head is mainly supplied by an anterior retinaculum (originating from the medial femoral circumflex artery) and a posterior retinaculum (originating from the lateral femoral circumflex artery). Vascular foramina were predominantly located anteriorly and posteriorly whereas superiorly (the zone of maximum asphericity in the sheep femur) only a clearly lower percentage of vessel entries were found. The osteochondroplasty area is also free of vascular foramina in more than 70% of all cases.
Discussion/Conclusion: Similar to human beings, the ovine femoral head blood supply is provided through two main retinacular vessel branches located anteriorly and posteriorly. Unlike human beings, the superior femoral head-neck junction is free of vessels in the vast majority of cases. A superior femoral head-neck osteochondroplasty can be performed safely in sheep hips. This enhances the potential of the experimental sheep model for FAI.

FM 2

Legg-Calvé-Perthes disease leads to atrophy and degeneration of hip abductor muscles

Dr. Markus Simon Hanke, Inselspital Universitätsspital Bern, Bern/CH; Dr. Simon Damian Steppacher, Inselspital, University of Bern, Bern/CH; Dr. Stefan F Werlen, Sonnenhof – Lindenhofgruppe, Bern/CH; Prof. Dr. med. Klaus-Arno Siebenrock, Inselspital, University of Bern, Bern/CH; Prof. Dr. Moritz Tannast, Inselspital, University of Bern, Bern/CH

Introduction: Legg-Calvé-Perthes disease (LCPD) results in a complex deformity of the hip with a mushroom-shaped femoral head, a short femoral neck, and a high-riding greater trochanter. The altered anatomy of the proximal femur has a direct impact on the leverage of the periarticular muscles, in particular of the hip abductors. We therefore asked if hip muscles in LCPD show (1) atrophy (decreased muscle diameter or cross-sectional area [CSA]) and (2) fatty infiltration compared to normal hips.
Methods: We retrospectively quantified the anatomy of 18 periarticular hip muscles using MR arthrography. We evaluated muscle diameter, CSA, and fatty infiltration according to Goutallier. A series of 68 hips (67 patients) with sequelae of LCPD were compared to a series of 23 normal hips (17 patients). The two study groups did not differ in terms of age (both 25 years, $p = 0.95$) or side (46% vs 48% of right hips, $p = 0.86$).
Results: Hip abductors (gluteus medius and minimus) showed a decreased diameter and CSA as well as an increased fatty infiltration. External rotators (obturator internus and externus, gemelli, and quadratus femoris muscle) showed a decreased diameter and CSA. No difference was found for the piriformis, pectineus and sartorius muscle.
Conclusion: Periarticular hip muscles in patients with LCPD show atrophy and fatty infiltration of abductors and external rotators. Hip preserving surgery in LCPD should aim in correcting the altered hip morphology and therefore optimizing muscle leverage.

FM 3

The anatomy of the lateral intermuscular septum perforating vessels and its surgical implications for the lateral subvastus approach to the femur

Dr. Karl Grob, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Mirjana Manestar, Anatomisches Institut der Universität Zürich-Irchel/CH; Axel Lang, Anatomisches Institut der Universität Zürich-Irchel/CH; Prof. Tim Ackland, Sport Science, Exercise and Health, UWA/AU; PD Dr. Helen Gilbey, Hollywood Functional Rehabilitation Clinic/CH; Prof. Dr. Markus Kuster, Royal Perth Hospital, Australia/AU

Introduction: With an open reduction technique for the treatment of femur fractures, the vessels that perforate the lateral intermuscular septum (LISP-vessels) must be ligated. The effect of this procedure on the blood supply to the femur remains unclear. The purpose of the current study was to investigate the anatomy of the LISP-vessels and the anastomoses around the femur with special emphasis on the lateral subvastus approach.
Materials: In six human cadavers the LISP vessels were ligated by a lateral approach on one side. After bilateral injection of different coloured silicon dyes into the lateral and medial femoral circumflex artery (green), deep femoral artery (red) and the superficial femoral artery (blue) dissection was performed bilaterally with the intention 1. to study the anatomy of the LISP vessels and its contribution to the blood supply of the femur and 2. to compare the arterial perfusion on both sides.
Results: The LISP vessels aid in the perfusion of the femur and quadriceps muscle group. Periosteal branches separate from the LISP vessels immediately after perforating the lateral intermuscular septum. The medullary perfusion of the femur was not altered by the ligation of the LISP vessels. The LISP vessels were shown to be a part of a complex anastomotic network. The linea aspera proved to be an important carrier of the femoral blood supply.
Discussion: The visualization of the femur through an open lateral subvastus access with ligation of LISP vessels inevitably causes a certain degree of soft tissue trauma. However, the disadvantages of this approach as compared to closed minimally invasive techniques may be reduced by using an adapted and careful open technique.
Conclusions: The perfusion of the femur can be compensated by a potent anastomotic network. When approaching the femur 1. The LISP vessels should not be ligated too closely to their point of exit, 2. The linea aspera should never be exposed or damaged during plate osteosynthesis.

FM 4

A bibliometric analysis of citation classics in orthopaedic hip research

PD Dr. Frank Michael Klenke, Inselspital, Bern University Hospital, Bern/CH; Dr. Christoph Emanuel Albers, Inselspital Bern, Universität Bern, Bern/CH; Dr. Sufian. S. Ahmad, Inselspital Bern/CH; Dr. Lorenz Büchler, Spitalzentrum Biel, Biel/CH; Prof. Dr. med. Klaus-Arno Siebenrock, Inselspital, University of Bern, Bern/CH; Dr. Sandro Kohl, Inselspital Bern, Bern/CH; PD Dr. med. Martin Beck, Kantonspital Luzern, Luzern/CH

Introduction: Bibliometric science aims at analyzing the qualities and scholarly impact of research within a specific field. The aim is at highlighting the nodes in the network of research and reflecting on the quality of research in a field. The aim of this study was to identify the classics in the field of hip research and analyze their qualities.
Methods: Using the database of the institute for scientific information, all hip joint related articles under the subject categories orthopaedics, rheumatology and radiology were identified and the hundred most cited selected for subsequent analysis of citation count, current citation rate (citations in 2013), -density (citations/article age), authorship, geographic origin institution, and level of evidence (LOE).
Results: In a total of 121 journals, 1,311,851 articles were published between 1945 and 2013, of which 1,287 (0.1%) possessed ≥250 citations. Total citations per article for the 100 most-cited ranged from 290 to 3144 citations. The most common areas of research were degenerative disease & arthroplasty, followed by hip preserving surgery for which the leading authors were William H. Harris and Reinhold Ganz respectively. All authors of multiple classics in the list

showed a single-topic focus. All articles were published in 8 journals and originated from 9 countries. Ten institutes published 48/100 of the articles. There was a negative correlation between both citation rate, -density and article age. Total citation count was highest for articles published between 1970 and 2000.
Conclusion: The study provides an analytical point of view of intellectual milestones in the field of hip research, reflecting on some of the qualities and characteristics of research in the field. Degenerative hip disease & Arthroplasty research take up the greatest proportion of citations, followed by research on hip preserving surgery. Authors of multiple classics showed a single-topic focus. LOE was low for classics, emphasizing the presence of other factors influencing citation count. Knowledge in study design and clinical research evaluation is essential to ensure correct citation practice and flow of evidence.

FM 5

Mid-term results of one- and two-stage exchanges of infected total hip arthroplasty using uncemented revision stems

Dr. Philipp Born, Kantonsspital Baselland, Davos Platz/CH; Prof. Dr. Werner Zimmerli, Kantonsspital Baselland, Liestal/CH; Dr. Lukas Zwicky, Kantonsspital Baselland, Liestal/CH; Prof. Dr. Peter Ochsner, Kantonsspital Baselland, Liestal/CH; PD Dr. Thomas Ilchmann, LEONARDO – Ärzte für Orthopädie und Traumatologie, Münchenstein/CH; Dr. Martin Clauss, Kantonsspital Baselland, Liestal/CH

Treatment of prosthetic joint infections (PJI) after Total Hip Arthroplasty (THA) is complex and strategies are discussed controversially. In one- & two-stage exchanges, cemented stems are frequently used. We report our mid- to long-term results of PJI treated with uncemented stems. 80 cases of PJI after THA were treated with uncemented stems from 01/1993 to 12/2012 and followed prospectively. Selection occurred for one- (n = 27) or two-stage (n = 53) exchange according to the Liestal algorithm. Surgical approaches were transfemoral (n = 58), transgluteal (n = 9) or transtrochanteric (n = 13). A monoblock (Wagner SL, n = 58) or modular (Revitan, n = 22) revision stem was implanted. On the acetabular side 44 Müller rings, 33 Burch-Schneider cages (combined with a cemented PE-cup) and 3 press-fit cups were used. Kaplan-Meier survival was calculated for endpoints (a) persistence of infection, (b) septic/aseptic stem loosening. Radiographs were analysed for (a) subsidence, (b) distal stem integration, (c) changes in cortical thickness, (d) proximal femur restoration, (e) radiolucency around stem/cup. Mean FU was 5.2 (2–15) years. PJI was eradicated in 77 of 80 cases (96%). 3 patients (all two-stage) had a treatment failure. 2 were treated successfully with an additional two-stage exchange. In the 3rd patient we were not able to control infection and exarticulation was performed. Furthermore, 1 stem was revised for aseptic loosening (5 years), 1 for a broken Wagner stem (7 years) and 1 for subsidence (8 months). Stem survival after 5 years was 93% (SD ±2.5 years). 2 cups were revised for aseptic loosening and 1 for recurrent dislocations. Subsidence ≥5 mm was found in 6 cases and occurred always within 3 months after surgery independent of stem type (p = 0.947) and approach (p = 0.691). Proximal femoral remodelling after transfemoral approach was excellent or good in 71% (32 excellent, 9 good) with no difference between one-/two-stage exchanges (p = 0.288). Initial distal stem integration was 65 mm medial and 66 mm lateral and increased to 8 mm medial (p = 0.716) and 10 mm lateral (p <0.001). Cortical thickness was unchanged over the entire FU period (p = 0.493). Radiolucencies were seen around 26 stems, only the stem revised after 5 years was rated loose. Eradication of PJI was high using our established protocol even with uncemented revision stems. Mid-term survival was independent from one-/two-stage revision and comparable to results for aseptic loosening revision.

FM 6

Fatty infiltration and muscle strength of the iliopsoas muscle after proximal femur fracture with dislocation of the lesser trochanter

Matthias Schenkel, Orthopädie Zentrum Kantonsspitäler Aarau u. Baden, Baden/CH; Tim Fischer, KS Baden, Radiologie/CH; Tobias Bühler, Orthopädiezentrum Kantonsspitäler Aarau/Baden, Aarau/CH; Suzanne Anderson, KS Baden, Radiologie/CH; PD Dr. Karim Eid, Orthopädiezentrum Kantonsspitäler Aarau/Baden, Aarau/CH

Introduction: Fatty infiltration of retracted muscles is a well-documented phenomenon in the rotator cuff of the shoulder. However, whether a similar infiltration is observed with retraction of the iliopsoas in the presence of trochanteric fractures is not known. Additionally, there is no consensus on whether or not the lesser trochanter should be refixed, particularly in younger patients. We hypothesized, that the iliopsas muscle would undergo fatty infiltration in relation to shortening of the musculotendinous unit and to duration from the fracture.
Methods: Eight patients with fracture dislocation of the proximal femur and lesser trochanter of more than 2 cm were reviewed at a minimum 6 months postoperatively. Inclusion criteria were normal and painfree activity of daily living. Patients were clinically assessed and MRI T1 weighted transverse images were performed. Fatty infiltration of psoas and iliacus muscles was assessed according to Goutallier and compared to the contralateral control side at three designated levels. Flexion of the hip was measured clinically and by the BTE Primus in supine position in 0 and 30 degrees hip flexion.
Results: Compared to the contralateral normal side, there was evidence of fatty infiltration on the posttraumatic side predominantly within the psoas muscle. Goutallier grade 3 was evident at the longest time interval from injury. There was a trend of increased fatty atrophy with higher age and longer time interval from the fracture. Clinical hip flexion testing showed a significant decrease of 110N (±24) compaired to the contralateral non injured side 130N (±29, p = 0.04).
Conclusion: To our knowledge, this is the first report documening fatty infiltration of the iliopsoas muscle after dislocation of the lesser trochanter. This correlated with a significant but clinically asymptomatic decrease of hip flexion strength.

FM 7

Plate positioning in periprosthetic femur fractures with stable implants – a biomechanical study

Dr. Matthias Walcher, Orthopädische Klinik König-Ludwig-Haus, Würzburg/DE; Dr. Karlmeinrad Giesinger, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Ryan du Sart/AU; Dr. Robert Day/AU; Prof. Dr. Markus Kuster, Royal Perth Hospital, Australia/AU

Introduction: Angular stable plate fixation is a widely accepted treatment option for periprosthetic femoral fractures with stable implants. There is no conclusive evidence for the optimal plate position concerning distance or overlap between the tip of the implants.
Methods: 38 composite femur models (SawboneTM) were reamed up to a diameter of 23 mm to create an osteoporotic bone model. A weber hip prosthesis stem (Zimmer TM) was cemented (palacos TM) into each femur using 3rd generation cementing techniques. A distal femoral NCB plate (ZimmerTM) was attached to each femur with a distance to the tip of the stem varying from 8 cm distance to 6 cm overlap in 2 cm steps. Each specimen was mounted to a servohydraulic polyaxial testing machine (Instron 8874). The specimens were tested in axial load of up to 1500 N and torsional load of up to 50 Nm. 3D-surface strain on the femur around the tip of the plate was measured with a 3-dimensional image correlation system (Limess™). Load to failure was tested at the end of each trial in axial loading.
Results: 3 Specimen failed early in the axial and 4 in the torsion testing. All early failures occurred between 2 cm overlap and 2 cm distance. Specimens were divided into a far group with a distance between the implants or an overlap of more than 4 cm and a close group within 4 cm distance or overlap. Specific failure patterns could be identified. Strain was significantly higher in the close group, and the load to failure significantly lower.
Conclusions: Placing the plate within 4 cm distance or 4 cm overlap to the femoral stem jeopardizes for implant failure in falls and for fatigue fractures. These results apply only for osteoporotic bone. A minimal gap of 6 cm or an overlap of the plate and the femoral stem of at least 4 cm is recommended in periprosthetic femur fractures to avoid stress risers.

FM 8

Validation of the Penrod Score for the Swiss Healthcare system: a reliable instrument for the outcome prediction in geriatric hip fracture patients!

Dr. Sebastian Müller, Universitätsspital Basel, Basel/CH; Saleh Hatem al Fadel, Universitätsspital Basel/CH; Prof. Dr. Marcel Jakob, Universitätsspital Basel, Basel/CH; Bojana Savic, Universitätsspital Basel/CH; Dr. Patrick Studer, Universitätsspital Basel, Basel/CH; Prof. Dr. Norbert Suhm, Universitätsspital Basel, Basel/CH

Introduction: Geriatric hip fracture patients are a very heterogeneous collective, what distinctly aggravates the best possible treatment in clinical routine. For this reason, accurate instruments and classifications, already delivering an early, reliable prognosis of the patients' outcome become more and more important. The 2007 for the anglo-american area established Penrod score subdivides the patient collective into 7 more homogenous groups and predicts the 6 months- postoperative outcomes of each group regarding mobility and

the functionality in daily life (ADL). In our pilot study, we aimed to validate the prognostic value of the Penrod Score for the Swiss Healthcare system.
Methods: Between June and December 2013 data from 51 patients treated for geriatric hip fractures in our geriatric fracture center could be collected. While Patients are assigned to Penrod Cluster 1 only because of their age (<75 years), in Clusters 2 (75–84 years) and 3 (>85 years), additionally the functionality and the cognitive status determine the assignment to the different subgroups (4 activities of daily life- washing, dressing, eating and using the bathroom: 2-4 ADL: 2A, 0-1: 2B, 4: 3A, 2-3: 3B, 0-1: 3C and D, dementia: Cluster 3D). In order to assess whether the predictions of the collected Penrod Score could be confirmed, age, functionality as well as the cognitive status of each patient was noted.
Results: In cluster 1 77.7% were able to walk independently after 6 months in our patient cohort (65,8% Penrod) and 77.7% were able to handle all 4 ADL (52.9%). In Cluster 2A and 3A 66,6% and 71.4% were able to independently fulfill all 4 ADL, compared to 40.6% and 31.5% previously predicted. In category 2B 50% (3.6% Penrod) of our patients achieved all ADL independently, in Clusters 3B 28,6 % (9.4% Penrod) whereas none of the patients in Clusters 3C and 3D could perform 4 ADLs anymore (2.2%, 0% Penrod).
Conclusion: Our findings validate and confirm the prognostic value of the Penrod Score for treatment of geriatric hip fracture patients. Regardless of age, the better the preoperative functional status of our patients was, the better the postoperative outcome. A limitation of this pilot study is the relatively small number of patients. However, our results outperform the findings of Penrod et al, thus already proofing the benefits of the individualized and focused measures of a specialized geriatric fracture center in terms of the functional outcomes after geriatric hip fractures.

FM 9

"Swiss Fracture Liaison Service" – secondary fracture prevention becomes a standard of care!

Prof. Dr. Norbert Suhm, Universitätsspital Basel, Basel/CH; Evelyn Kungler/CH; Bojana Savic, Universitätsspital Basel/CH; Dr. Patrick Studer, Universitätsspital Basel, Basel/CH; Prof. Dr. Marcel Jakob, Universitätsspital Basel, Basel/CH

Introduction: In parallel with demographic change osteoporotic fractures will become more frequent in the future. International guidelines therefore require arrangements of secondary fracture prevention shall be offered to elderly patients who suffered from a fragility fracture. While treating the acute fracture, prevention of future fractures is neglected: according to the literature, only as little as 22% of fragility fracture patients receive the diagnostics and treatment they deserve. The Fracture Liaison Service (FLS) has proven its efficacy to improve this situation: the orthopaedic surgeon identifies candidate patients based on age and fracture pattern. The FLS-team then takes the task to decide which measures of secondary fracture prevention are looked upon adequate for the individual patient.
Methods: "Swiss Fracture Liaison Service" is an initiative of the Swiss Association against Osteoporosis. FLS like structures shall be implemented with the help of the national societies in order to make secondary fracture prevention become a national standard of care in the future. In Switzerland it is unknown, which FLS equivalent structures already exist. By the help of the associations SGOT, SGACT and SGC we have therefore assessed the situation as a first step. Orthopaedic departments were asked to report on the number of fragility fracture patients they treat per year in their clinic, if FLS like structures already exist or if they were interested to establish such structures, and which additional departments apart from orthopaedics would likely be involved in such a network.
Results: 29 departments reported back: 9 amongst them treat less than 50 fragility fracture patients, 7 departments treat 50 or more but less than 100 patients and 13 of these hospitals treat 100 or more patients with fragility fracture annually. 9 of these departments claimed they already run a FLS and all the others announced they were interested to establish such a system in the future. Apart from Orthopaedics this would comprise Medicine and Endocrinology in 13 cases, Radiology in 16 departments, Rheumatology in 13 hospitals, and other disciplines in 8 departments.
Conclusion: The number of patients treated and the lively interest of the orthopaedic clinics that answered indicates the relevance of the topic. Those hospitals identified with our first step are looked upon candidates to implement and enlarge FLS like structures on different levels of care in the near future.

FM 10

Histological characterization of hip cement restrictor induced osteolysis in the femur

Dr. Matthias Erschbamer, St. Gallen/CH; Dr. Daniel Bjasch/CH; Dr. Christian Oehlschlegel/CH; Dr. Karl Grob, Kantonsspital St. Gallen, St. Gallen/CH

Abstract: Cement restrictors are part of modern cemented hip arthroplasty. They enable firm cementation of the prosthetic stem and prevent excessive cement leakage into the femur. Biodegradable cement restrictors (BCR) obviate the need for removal during revision surgery, however it has been shown that some cement restrictors, consisting of PolyActive, induce osteolysis similar to other foreign material.
Methods: In a series of more than 1000 patients, a BCR (SynPlug®, 1000PEGT70PBT30 PolyActive), that is known to induce osteolysis, was used. We identified five patients that underwent revision surgery due to symptomatic aseptic loosening of the prosthetic stem and concomitant BCR induced osteolysis. In these patients we performed a detailed histological and radiological analysis.
Results: In these five patients we were able to detect a radiological atypical loosening pattern, starting peri-focal to the BCR at the tip of the stem in Gruen zone 4 and subsequently ascending proximally into zone 3 and 5. Tissue analysis from these five patients revealed histological patterns with marked remnants of the BCR even several years after implantation. Partially degraded parts of the BCR were surrounded by a vast number of inflammatory cells. In the vicinity of the BCR non-vital trabecular bone material could be observed, with accumulation of foam cells filled with degraded material of the former cement restrictor. Bone resorption was apparent with only a sparse number of osteoblasts. These findings are similar to foreign material induced osteolysis. A thick cement interface between the BCR and the tip of the prosthetic stem appeared to prevent the ascension of osteolysis.
Conclusion: We found that the BCR (SynPlug, 1000PEGT70PBT30 PolyActive) reabsorbs very slowly and remnants and signs of inflammation can be found even after several years. This type of restrictor induces a chronic inflammatory reaction that can lead to progressive osteolysis and symptomatic loosening of the stem, necessitating early complex revision surgery. A good cement interface proximal to the BCR might prevent the ascension of osteolysis.

FM 11

Predictors for failure 10-years after surgical hip dislocation for femoroacetabular impingement – an MRI study

Dr. Markus Simon Hanke, Inselspital Universitätsspital Bern, Bern/CH; Dr. Simon Damian Steppacher, Inselspital, University of Bern, Bern/CH; Dr. Helen Anwander, Inselspital Bern, Bern/CH; Dr. Stefan F Werlen, Sonnenhof – Lindenhofgruppe, Bern/CH; Prof. Dr. med. Klaus-Arno Siebenrock, Inselspital, University of Bern, Bern/CH; Prof. Dr. Moritz Tannast, Inselspital, University of Bern, Bern/CH

Introduction: Magnetic resonance imaging with intraarticular contrast (arthro-MRI) and radial cuts is the gold standard to evaluate chondrolabral lesions in the setting of femoroacetabular impingement (FAI). Existing follow-up studies for surgical treatment of FAI have evaluated negative predictors based on preoperative clinical examination, intraoperative findings and conventional radiography. However, no study exists that evaluated the potential of preoperative arthro-MRIs to predict failures after surgical treatment of FAI in the long term. The purpose of this study was to detect potential predictors for failure after surgical hip dislocation (SHD) for FAI based on specific preoperative arthro-MRIs of the hip at a minimum follow-up of 10 years.
Methods: We performed a retrospective study involving 97 consecutive hips (75 patients) undergoing SHD for FAI between July 2001 and March 2003. The following subtle degenerative features were assessed on the preoperative arthro-MRI: extend of labral/cartilage damage, presence of osseous/perilabral cysts, labral ganglia, perifovealar/posteroinferior/central/lateral beginning osteophytes, subtle joint decentration. Patients were then evaluated clinically and radiographically at a minimum follow-up of 10 years (mean 11.0 years). Univariate and multivariate Cox-regression analyses were performed with the following endpoints as failures: conversion to total hip arthroplasty, radiographic evidence of progression of osteoarthritis, and/or a Merle d'Aubigné-Postel score of less than 15 indicating a poor clinical result.
Results: Failed hips at a 10-year follow up where more likely to show decentration of the femoral head (hazard ratio with 95% confidence interval, 3.7 [2.8–4.7], p = 0.007), perifovealar osteophytes

(4.9 (3.8–6.0), p = 0.004), posteroinferior osteophytes (4.6 (3.6–5.6), p = 0.02), central osteophytes (4.4 (3.5–5.4), p = 0.002), chondral damage >2 hours (5.9 (5.0–6.9), p <0.001), labral damage >4 hours (7.6 (6.2–9.1), p = 0.007), perilabral cysts (3.8 (2.8–4.8), p = 0.007).
Conclusion: Preoperative arthro-MRIs with radial cuts reveal important predictors for failure of surgical treatment for FAI. Most of these factors are not visible on conventional radiographs or standard hip MRIs. Preoperative arthro-MRI evaluation is therefore strongly recommended on a routine basis. The found negative predictors should be incorporated in the decision making process in patients considered for joint preserving hip surgery.

FM 12

Prevalence and functional consequences of femoroacetabular impingement: exploratory cross-sectional study in male youth ice hockey players

Romana Brunner, Schulthess Klinik, Zürich/CH; Dr. Nicola A. Maffiuletti, Schulthess Klinik, Zürich/CH; Dr. Nicola C. Casartelli, Schulthess Klinik, Zürich/CH; Dr. Mario Bizzini/CH; PD Dr. Reto Sutter/CH; Prof. Dr. Christian Pfirrmann/CH; PD Dr. Michael Leunig, Schulthess Klinik, Zurich/CH

Introduction: The prevalence of femoroacetabular impingement (FAI) and associated degenerative changes is high in adult ice hockey players. So far, no information exists on FAI-related bony deformities and symptoms in youth ice hockey players and especially whether they may lead to functional alterations as reflected in hip muscle strength, range of motion (ROM) and on-ice physical performance.
Methods: Seventy-four male youth ice hockey players with a mean age of 16 years (range 12 to 20) were bilaterally evaluated for passive hip internal rotation ROM using an examination chair. Only the side with less internal rotation ROM was further investigated. FAI-related bony deformities were evaluated with magnetic resonance imaging. The involved hip was classified as symptomatic or asymptomatic based on the presence of hip pain during exercise and on the flexion-adduction-internal rotation (FADIR) provocation test. Hip muscle strength, passive hip ROM, and on-ice physical performance were also evaluated.
Results: Fifty of 74 players (68%) had FAI-related bony deformities, of whom 16 (22%) were symptomatic. A total of 20 players showed signs of a cam deformity (27%), 17 of a pincer deformity (23%) and 13 demonstrated combined deformities (18%). With respect to hip muscle strength, hip ROM and on-ice physical performance no significant differences were observed between players with no FAI, asymptomatic or symptomatic FAI.
Conclusion: Despite a high prevalence of FAI-related bony deformities in youth ice hockey players (2 out of 3), players with symptomatic or asymptomatic FAI did not show functional impairments in terms of hip muscle strength, hip ROM and on-ice physical performance. Further research is needed to verify if functional limitations will develop in later stages of the FAI pathomechanical process.

FM 13

Mean 10-year follow-up of surgical hip dislocation for protrusio acetabuli – a controlled study

Dr. Markus Simon Hanke, Inselspital Universitätsspital Bern, Bern/CH; Dr. Simon Damian Steppacher, Inselspital, University of Bern, Bern/CH; Dr. Corinne Andrea Zurmühle, Inselspital, University of Bern, Bern/CH; Prof. Dr. med. Klaus-Arno Siebenrock, Inselspital, University of Bern, Bern/CH; Prof. Dr. Moritz Tannast, Inselspital, University of Bern, Bern/CH

Introduction: Protrusio acetabuli is a reported cause of pain and hip osteoarthritis and represents the most severe form of pincer-type femoroacetabular impingement (FAI). The currently proposed surgical treatment is circumferential acetabular rim trimming through a surgical hip dislocation. However, no mid- to long-term follow up of this procedure is available in literature up to date. The aim of this study was to evaluate the long-term follow-up of patients undergoing open circumferential acetabular rim trimming in protrusio hips. We asked if the mean 10-year follow-up of patients with circumferential rim trimming for protrusio acetabuli differs from patients treated with surgical hip dislocation for femoroacetabular impingement without severe overcoverage.
Methods: A retrospective comparative study of two consecutive groups was performed: the 'protrusio' group (31 patients [38 hips]) and the 'control' group (65 patients [86 hips]). The control group consisted of hips treated with a surgical hip dislocation for FAI and did not include hips with a positive protrusio sign or a lateral center edge angle >39°. Patients were followed clinically and radiographically at a follow-up of 10 years (protrusio group) and 11 years (control group). We assessed the Merle d'Aubigné/Harris Hip/HOOS Scores, WOMAC, and UCLA activity score. A Kaplan-Meier survivorship analysis of the hip was calculated with the following endpoints for the two groups: conversion to THA, a low clinical score, and/or progression of osteoarthritis.
Results: We found a significantly (p = 0.009) decreased survivorship of the hip for the protrusio group (59% [95% confidence interval, 42–76%) compared to control group (83% (95% CI, 75–91%,) with the endpoints stated above.
Conclusion: Approximately six out of 10 patients undergoing open circumferential rim trimming have a good clinical result without progression of osteoarthritis and/or conversion to THA at 10 years. However, the results are clearly inferior compared to surgical hip dislocation for FAI without severe overcoverage.

FM 14

Midterm results of FAI surgery – association with generalized joint hypermobility?

Dr. Florian D. Naal, Schulthess Klinik, Zürich/CH; Aileen Müller, Schulthess Klinik/CH; Dr. Franco M. Impellizzeri, Schulthess Klinik/CH; Vanessa Wellauer, Schulthess Klinik, Zürich/CH; PD Dr. Michael Leunig, Schulthess Klinik, Zurich/CH

Introduction: The concept of femoroacetabular impingement (FAI) is widely accepted today. Surgical treatment, either arthroscopic or open, yields in satisfactory outcomes in about 70 to 80% of the cases. Besides other known confounders, generalized joint hypermobility (JH) might be another risk factor for poorer results considering that a hypermobile joint becomes even more mobile after FAI correction. This study therefore aimed to determine the results of FAI surgery (arthroscopy, surgical hip dislocation (SHD), anterolateral (AL) approach) at two-to-five years postoperatively and to analyze the association with JH.
Methods: This retrospective cohort study included 234 patients (119 females, mean age 35.6 years) with 249 hips treated. There were 137 arthroscopies and 112 open procedures. Conversions to total hip arthroplasty (THA) and revisions were noted prospectively. Before surgery all patients completed a questionnaire-set consisting of the Oxford Hip Score, the EQ5D and the UCLA activity scale. At follow-up, additionally completed were: the self-reported Beighton Score (assessment of JH), the COMI Hip, the Hip Sports Activity Scale, and satisfaction and transition questions.
Results: Thirteen hips (5.2%) were converted to THA at a mean of 25 months after FAI surgery (7 after scope, 6 after AL approach). Nine hips (3.6%) underwent major revision (7 after scope, 1 after SHD, 1 after AL approach). All patient-reported outcome scores improved significantly. Overall, 78.4% were satisfied or very satisfied with the result of surgery, 72% indicated that surgery has helped or helped a lot. According to a cut-off of > = 4 points on the Beighton Score 35% of the patients had JH, 19% with a cut-off of > = 6. After controlling for age and gender, we could not find significant differences in satisfaction ratings or outcome scores between patients with JH and those without. Eight of the 13 THA conversions (62%) and five of the nine major revisions (56%) had Beighton Scores > = 4.
Conclusion: Two-to-five years after FAI surgery about 75% of the patients were subjectively satisfied with the achieved result. Conversion- and revision rates were comparable to those reported in the literature. JH could be frequently observed in the present FAI cohort. While JH had no effect on self-reported outcome scores or satisfaction rates, there seemed to be some association with conversion to THA or major revision, particularly capsular revision.

FM 15

Anterior luxation test: prospective validation of a new clinical test to assess injury of ligamentum teres related hip instability

Luciano Agnello, Ospedale San Giovanni Bellinzona, Lugano/CH

Introduction: Ligamentum teres (LT) has a role in hip biomechanics, stability, nociception and proprioception. Lesions of LT may be associated with pain and/or instability of the hip. No reliable clinical test has been described to elicit instability in hip related with LT injuries.
Materials and methods: Three independent examiners, blinded to radiological findings, assessed a prospective cohort of patients prior to undergoing hip arthroscopy. LT tears were recorded according to Gray-Villar classification. Sensitivity, specificity, positive and negative predictive value (PPV, NPV) was calculated. The test is performed with

the patient supine and hip in loose-pack position. The examiner places one hand on the posterior aspect of great trochanter while the weight of the thigh is taken by the forearm and a second hand in the groin to stabilise the pelvis anteriorly, than attempts to translate the femoral head anteriorly by applying a force directed on the great trochanter. Examiner feels for anterior translation, the end point and apprehension comparing it with opposite side. A positive test is anterior translation of the hip with or without pain.
Results: 58 patients including 32 (55%) females and 26 (45%) males. We identified 21 positive and 37 negative results for LT injury. Results were confirmed with hip arthroscopy images. There were 4 false-negative and false-positive tests each. Sensitivity was 90%, specificity 84%. PPV and NPV were 90% and 84% respectively. Partial tears (19/58) were treated with shrinkage of LT and two cases of complete tear underwent LT allograft reconstruction. Discussion The test offers assessment of instability associated with LT injuries. Test emphasises anterior translation of femoral head with respect to fixed pelvis. Provocation of pain can be associated with partial tears and occasionally in complete tears with accompanying synovitis. The test is performed with hip in loose-pack position that potentially avoids false positive results.
Conclusion: Our experience shows that the AL test is easily reproducible and highly specific for the diagnosis of lesions of the LT. The test can be performed to identify both acute and chronic LT injuries. Like any clinical examination technique the clinician is recommended to learn, practice and compare in patients to interpret the results better and improve predictability. We suggest should be used as a special clinical test in conjunction with thorough history and conventional hip examination.

FM 16

Return to sport after hip surgery for femoroacetabular impingement: a systematic review

Dr. Nicola C. Casartelli, Schulthess Klinik, Zürich/CH; PD Dr. Michael Leunig, Schulthess Klinik, Zurich/CH; Dr. Nicola A. Maffiuletti, Schulthess Klinik, Zürich/CH; Dr. Mario Bizzini/CH

Introduction: Many athletes present with hip pain and functional disability related to femoroacetabular impingement (FAI). Hip surgery is often an option for the management of symptomatic FAI, and return to sport after hip surgery is of particular concern for athletes. The aim of this systematic review was to appraise: (1) the rate of return to sport of athletes after hip surgery for FAI, and (2) some aspects that may influence the return to sport.
Methods: Four databases (Embase, Pubmed, Web of Science, Cochrane Library) were searched until the 21st October 2014. Studies evaluated return to sport of athletes who underwent hip surgery for the treatment of a symptomatic FAI. A validated tool was used for methodological quality evaluation of the studies. Return to sport was further investigated considering the following aspects: (1) level of competition of athletes, (2) time of follow-up evaluation, (3) associated sport-related outcomes reported by athletes, and (4) amount of cartilage lesions at the time of hip surgery.
Results: A total of 18 case series (Level of Evidence IV) with moderate-to-high methodological quality were included. On average, 87% of athletes returned to sport after hip surgery for FAI, and 82% returned to the same sport level as before the occurrence of symptoms. Professional athletes seem to return to sport at a higher rate compared with recreational and collegiate athletes. Sport participation after hip arthroscopy tends to decrease over time for professional athletes at short- and mid-term follow-ups. Diffuse hip osteoarthritis at the time of hip surgery may not allow athletes to return to sport. In addition, return to sport was not always positively associated with the actual satisfaction and sport ability of athletes.
Conclusion: Athletes return to sport after hip surgery for the treatment of symptomatic FAI at relatively high rates. The level of competition, the time of evaluation, and the amount of cartilage lesions at the time of hip surgery may influence the return to sport of athletes. Return to sport should not be used as a single outcome for evaluating the success of hip surgery. Future studies with higher levels of evidence should describe and evaluate return to sport protocols performed by athletes after hip surgery for FAI.

FM 17

Long-term follow-up 15 to 20 years after implantation of the Thrust Plate Hip Prosthesis – a critical analysis

Dr. Maja Kägi, Kantonsspital Graubünden, Chur/CH; Dr. Heinz H. Bereiter, Kantonsspital Graubünden/CH; Hilaire A.C. Jacob/CH; Dr. Martin L. Bürgi/CH

Introduction: The Thrust Plate Prostheses (TPP) was conceived with the aim of loading the proximal part of the femur as physiologically as possible, by the way of transmitting the hip joint force over a flat plate directly to the medial cortex of the femoral neck. Between the implantation of the first two prototypes in 1978, three generations of the TPP have involved, incorporating more biologically compatible materials and with design features, that simplify the surgical procedure.
Methods: Between November 1992 and January 1999 a total of 102 primary total hip arthroplasties using the definitive design of the TPP were implanted on 84 patients in the Canton's Hospital in Chur. Every TPP that was implanted during this period was prospectively followed up. So, we have now a overview of 102 prostheses with a mean follow-up period of 17.2 years (15–20.5 yrs) after implantation.
Results: Of the 84 patients listed, 20 had died and only 1 patient was lost to follow-up. Within 15 to 20 years after primary implantation of the 102 prostheses a total of 6 aseptic loosenings occured. This corresponds to a cumulated survival rate of 94.7% at 17 and 91.8% at 18 years. The Harrison hip score increased from 51.4 points to 94.3 points at the time of the last follow-up and the clinical follow up showed a high patient satisfaction. Partially we have specific radiological and implant related findings according the special design of the TPP. In relation to the various bone remodelling patterns observed, a radiological classification of 3 phenotypes was made.
Conclusion: In summary we may state that the thrust plate prosthesis is a good concept from a biomechanical point of view. Even though the TPP is no longer market because of its technical complexity and due to economic aspects, the specific characteristics of this clinically and radiologically successful prosthesis deserve attention. Under this aspect we will describe and discuss the specific radiological findings, as well as the design related characteristics. Furthermore, unexpected problems that were encountered during the long-term follow-up, mainly due to acquisition of patients and data retrieval, are mentioned and discuss.

FM 18

Long term results in two cohorts comparing operative and non operative treatment of anterior cruciate ligament rupture of the knee based on ability assessment by the Tegner score

Dr. Luzi Dubs, Praxis für Orthopädische Chirurgie, Winterthur/CH

Introduction: The optimal treatment of the ruptured anterior cruciate ligament (acl) remains still controversial. The legitimation for operative reconstruction is the intention to delay osteoarthritis in the long term outcome. In order to avoid score bias the most important and patient specific outcome measurement is the ability assessment by the Tegner score with regard to the physiological age related loss of abilities. The hypothesis of this study is the non inferiority of the conservative treatment after acl rupture.
Methods: Cohort I consists of 24 patients, 50% males, mean age at injury 29,1 (14–50), at follow up 54,9 (38–77) years, who received acl reconstruction before 1994 and in the majority less than one year after injury. Cohort II consists of 21 patients (24 knees), 92% males, mean age at injury 36 years (16–53), at follow-up 61 (39–71) years. They were refered due to severe meniscal lesion provided for arthroscopic treatment most of them between 1995 and 1998. The history and clinical examination showed an untreated acl rupture averaged 6 (0–39) years earlier. In both groups the patients were assessed by the Tegner score (1–10) before acl rupture and at final long term follow up on average 25,6 (22–32) years in cohort I and 24,3 (16–42) years in cohort II.
Results: The published mean physiological loss of abilities in the literature is one Tegner point over 20 years. The change of abilities in the two treatment groups was comparable and quite similar. Cohort I changed from 6,5 (4–10) to 4,1 (3–6)Tegner points with a difference of 2,4 points, Cohort II changed from 6,3 (4–9) Tegner points to 4,1 (2–6) with the difference of 2,2 points. To increase internal validity and to reduce the risk of selection bias a matched pair comparison of 14 patients in each group was analysed. The changes in abilities revealed no differences between the two cohorts.

Conclusions: The limitations and difficulties in data collection in the long term outcome of these comparative cohort studies have to be discussed. The conservative treatment cohort with severe meniscal lesions could more likely correspond to a negative selection group. With regard to this fact the non operative treatment appears not to be inferior to the operative reconstruction of acl rupture assessing one of the most important patient specific outcomes like the Tegner score in the long term view. Therefore the decision to the non operative treatment of acl rupture as the first choice procedure can be declared as justified.

FM 19

Biological induction in the healing of the anterior cruciate ligament

Dr. Sufian S. Ahmad, Bern/CH; Romina Cabra/CH; Dr. Sandro Kohl, Inselspital Bern, Bern/CH; Prof. Dr. Benjamin Gantenbein/CH

Background: In the healing process of the ACL and other intra-articular ligaments, the lack of fibrin-platelet clot formation leads to a persistent gap between the ruptured ends of the ligament. These correlated factors are considered major reasons for the poor healing capacity of the ACL. Although ACL surgical reconstruction has turned into the gold standard of care for ACL injuries, significant problems persist like ligament laxity, donor site morbidity, and pathogen transfer. The mentioned complications and the development of functional tissue engineering techniques have raised the interest in bio-enhanced ACL repair implementing regenerative approaches, such as platelet rich fibrin (PRF) and platelet rich plasma (PRP), in mechano-biological models of ACL. Further, these models require an internal control tissue for judging relative gene expression of intact ACL organ culture. Also the gene expression profile of donor-matched ACL versus PCL has never been investigated. We hypothesized that PRF and PRP would present different levels of efficacy in inducing the regeneration of the ligament. We also assumed that donor-matched posterior cruciate ligament (PCL) could be used as internal control for future in vitro mechano-biological model of ACL in organ culture.
Methods: Fibroblasts were cultured in a 3D collagen scaffold and divided in 4 treatments groups. Depending on their group cells were treated with PRF, TGF-β, PRP2.5% and 20% for 21 days. Cellular metabolic activity, gene expression for anabolic and catabolic genes, glycosaminoglycans (GAG), hydroxyproline and DNA content were measured every 7 days for 3 weeks. Additionally, quantitative RT-PCR for expression of anabolic and catabolic genes was performed in 9 donor-matched ACL and PCL.
Results: At day 21, PRP 20% outperformed PRP 2.5%, PRF and TGF-β in DNA content and relative expression of anabolic and catabolic genes. ACL fibroblasts treated with PRP 20% also had lower GAG content than those treated with PRF, PRP 2.5% and TGF-β after 3 weeks. Regarding the relative gene expression in donor-matched ACL and PCL, 85% of the analysed genes didn't show significant ($P > 0.05$) difference between ACL and PCL.
Conclusions: This study demonstrates that PRP 20% expresses stronger therapeutic effects than PRF on in-vitro expanded fibroblasts. Moreover, gene expression profile comparison of donor-matched ACL and PCL suggests that PCL can be used as internal control.

FM 20

Good video gamers are better arthroscopists

Dr. Thorsten Jentzsch, Universitätsklinik Balgrist, Zürich/CH; Dr. Stefan Rahm, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Burkhardt Seifert, Universität Zürich, Zürich/CH; Jan Farei-Campagna, UniversitätsSpital Zürich, Zürich/CH; Prof. Dr. Clément Werner, UniversitätsSpital Zürich, Zürich/CH; Dr. Samy Bouaicha, UniversitätsSpital Zürich, Zürich/CH

Introduction: Through the development of improved perceptual templates, numerous behavioral benefits, which include enhanced multi-tasking, attention, and hand-eye coordination, derive from video game play. Video game players are able to comprehend and perform a task much faster and better although they enter a task with the same skills. One study has investigated the relationship between video game experience and shoulder arthroscopy and other studies have shown an association between video games and laparoscopies. However, there are no studies about the correlation between performances on video games with varying visuospatial demands and arthroscopies.
Methods: The experience and performance in five different video games of variable genres was compared to the performance in three varying tasks of a validated virtual reality knee arthroscopy simulator in 30 volunteers*. Statistical analysis was carried out with a principal component analysis and Spearman's rank correlation. The significance level was set at p-values <0.01.
Results: We observed significant, positive correlations between video game experience / performance and knee arthroscopy simulator performance ($\varrho = 0.50$, $p = 0.005$ / $\varrho = 0.63$, $p < 0.001$). The performances in a 3-D dribbling sports game and first-person shooter showed the highest correlations with the arthroscopy task of catching six foreign bodies, while a 2-D tile-matching puzzle game correlated most strongly with the arthroscopic meniscus resection. There were no correlations between a 2-D strategy game and the knee arthroscopy simulator tasks.
Conclusion: This is the first study about the correlation between video game abilities and knee arthroscopy simulator performance. We were able to demonstrate a strong correlation between advanced video game skills and knee arthroscopy performance. While 2-D strategy video games that involve mathematical skills do not influence arthroscopy performances, a 2-D puzzle game that requires a limited focus correlated well with an arthroscopy task that also needed a limited focus only, complex 3-D sports and first-person shooters displayed the strongest correlations with multidimensional arthroscopy tasks that involved the highest amount of multi-tasking and hand-eye coordination. Therefore, 3-D video game training may improve arthroscopy performances.

Reference: *[Authors of this abstract] (2014): Superior Arthroscopy Performance of Skilled Video Game Players. Manuscript submitted for publication

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FM 21

Outcome of a 1 combined ACL and ALL reconstruction technique with a minimum 2-year follow-up

Dr Roland Gardon, Cabinet privé, Genolier/CH; Dr Bertrand Sonnery-Cottet, Centre Orthopédique Santy, Lyon, France, Lyon/FR; Dr Benjamin Freychet/FR; Dr Mathieu Thaunat/FR

Introduction: The anterolateral ligament has recently been identified as an important structure involved in rotational laxity after ACL rupture. Results of a combined anterior cruciate ligament and anterolateral ligament reconstruction technique have never been reported.
Methods: 92 patients underwent a combined anterior cruciate ligament and anterolateral ligament reconstruction. Indications for a combined procedure were associated Segond fracture, chronic anterior cruciate ligament lesion, grade 3 pivot-shift, high level sporting activity, pivoting sports, radiographic lateral femoral notch sign. Patients were assessed pre and post-operatively with objective and subjective IKDC, Lysholm scores and the Tegner activity scale. Instrumented knee testing was performed with the Rolimeter arthrometer. The KOOS score was obtained at the last follow-up. Complications including graft failure or contralateral anterior cruciate ligament rupture were also recorded.
Results: The mean follow-up time was 32.4 months (±3.9). One patient (1.1%) was lost to follow-up. One patient (1.1%) suffered an ACL graft rupture and 7 patients (7.6%) had a controlateral ACL rupture leaving 83 patients for final evaluation. At the last follow-up, all patients had a full ROM. The Lysholm score, subjective IKDC score, and objective IKDC score were significantly improved (all $P < .001$). The Tegner Activity Scale at the last follow up (7.1 ± 1.8) was slightly lower than before surgery (7.3 ± 1.7) ($P < .01$). The mean differential anterior laxity was 8 mm (± 1.9) before surgery and significantly decreased to 0.7 mm (± 0.8) at the last follow-up ($P < .001$). Pre-operatively 41 patients had a grade 1 pivot shift, 23 had a grade 2, and 19 had a grade 3 according to the IKDC criteria. Post-operatively, 76 patients had a negative pivot shift (grade 0) and 7 patients were grade 1 ($P < .001$).
Conclusion: This study demonstrates that a combined reconstruction can be an effective procedure without specific complications at a minimum follow-up of 2 years. Longer-term follow-up studies are necessary to determine whether these combined reconstruction improve the results of anterior cruciate ligament treatment.

FM 22

Outcome at 23 years after Acl reconstruction with bone tendon bone autograft

Dr Tiago Dos Santos, CHUV, Lausanne/CH; Dr Philippe Alves/CH; Prof. Dr Daniel Fritschy/CH; Dr Robin Martin/CH

Purpose: determine the long term outcome of anterior cruciate ligament reconstruction (ACLR) using bone tendon bone autograft (BTB).
Methods: All patients receiving primary ACLR with BTB performed between 1984 and 1999 by a single surgeon were included. Operative reports and clinical charts were retrospectively reviewed. Data from clinical exam and KOOS were collected. Up to date knee x-rays were analyzed for osteoarthritic changes (OA) and tunnels positions.

Results: 146 ACLRs were eligible, 43 lost to follow up. 5 patients were deceased. 98 operated knees were included (88 patients). Mean FU was 23.2 ± 4.4y. Mean age at surgery was 25.5 ± 6.6yo. Arthroscopy was the main technique (79.6%). Surgery was performed 1.8 ± 2.4y. after the injury. 21.3% sustained an ACL tear on the opposite knee, at 8.6 ± 5.5y. 64.9% of the patients went back to the same sport level. Revision surgery occurred in 21.4%, at 11.7 ± 10.1y, for medial (13.2%) or lateral (4.1%) menisectomy, revision ACLR (3.1%), osteotomy (1.0%), and total knee replacement (2.0%). ACLR failure rate was 12.8% based on an association of a difference in anterior translation of more than 5 mm at KT1000 exam and a soft end point at the Lachman test. 19.1% of the knees had a positive pivot shift test. 42% of the patients with a stable knee on clinical exam described a remaining fear for injury recurrence. Patients sustaining a partial menisectomy (n = 30) at time of ACLR had significantly lower KOOS pain component than patients with intact meniscus. Their sport component of the KOOS and total KOOS had also a tendency to be lower. 92.9% of knees that sustained a menisectomy had some degree of with OA changes in the related compartment (p <0.001). In patients with intact meniscus at the end of the follow up (n = 30), femoral tunnel malposition was not associated with increased incidence of OA changes. There was no differences in the severity of OA between these groups. Femoral tunnel malposition (n = 64) was neither associated with increased incidence of revision for menisectomy nor ACLR. It was associated with a tendency in lower KOOS sport component and total KOOS.
Conclusion: this long term follow up study shows that menisectomy but not femoral tunnel malposition is associated with increased risk of OA and pain after ALCR. A malposition of the femoral tunnel is rather associated with lower KOOS sport component. At 23 y, less than 1/6 of ACLR had failed but almost 1/2 of the patients had a remaining for injury recurrence.

FM 23

Concurrent injuries in 208 adolescent and skeletally immature patients undergoing ACL reconstruction

Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; Dr. Frances Tepolt, Children's Hospital Boston, Harvard Medical School/US; Prof. Dr. Mininder Kocher, Children's Hospital Boston, Harvard Medical School/US

Introduction: The purpose of this study was to assess the prevalence of and risk factor for concurrent structural damage in pediatric and adolescent patients undergoing ACL reconstruction during the academic year 2013/14 at a tertiary pediatric hospital.
Methods: Data on 208 patients undergoing ACL surgery were reviewed for additional meniscus and cartilage damage. Prevalences of such injuries were regressed on age, gender, BMI, and time between injury and surgery. Skeletally immature patients were analyzed as a subgroup. IRB consent was obtained for this study.
Results: 208 patients with a mean age of 15 ± 2 years were reviewed. 165 (79%) were treated with a hamstring autograft, 6 (3%) with a bone-patellar tendon-bone autograft, 6 (3%) with a hamstring auto-allograft hybrid, and 31 (15%) with an intra- and extra-articular stabilization with ITB. 56% had at least one concurrent injury. 66 (32%) had a medial meniscus tear, 72 (35%) had a lateral meniscus tear, 10 (5%) had a cartilage defect. Both BMI and time since injury were significant predictors for injury, with increase in prevalence of approximately 10% per point BMI and 6% per month passed between injury and surgery.
Conclusion: In summary, more than half of pediatric and adolescent patients treated for ACL injury suffered from a concurrent injury requiring additional treatment. The most important predictors were time since injury and BMI, These facts should be considered when counseling a patient with an ACL tear for or against surgery.

FM 24

Proximal tibial anterior closing wedge osteotomy in repeat revision of anterior cruciate ligament reconstruction

Dr Roland Gardon, Cabinet privé, Genolier/CH; Dr Bertrand Sonnery-Cottet, Centre Orthopédique Santy, Lyon, France, Lyon/FR; Dr Mathieu Thaunat/FR; Dr Jean-Marie Fayard/FR; Dr Benjamin Freychet/FR; Dr Pierre Chambat/FR

Introduction: Physicians should consider an increased posterior tibial slope (PTS) as a risk factor for graft failure when proposing anterior cruciate ligament (ACL) re-revision.
Methods: Between 2008 and 2010, 5 combined ACL re-revisions with proximal tibial anterior closing wedge osteotomy were retrospectively evaluated after a mean 31.6 months' follow-up (range, 23–45 months). All patients reported subjective knee instability preoperatively and demonstrated increased laxity on physical examination. Intrinsic risk factors for graft failure (excessive tibial slope) were identified in all cases. Preoperative and postoperative functional assessments included the International Knee Documentation Committee (IKDC) score along with the Lysholm score and Tegner activity scale.
Results: The mean Lysholm score was 46.2 preoperatively (range, 26–69) and 87.8 (range, 60–100) postoperatively. The mean IKDC subjective score was 39.5 (range, 21.8–64.4) before surgery and 79.1 (range, 48.3–98.9) at the last follow-up. The mean Tegner activity score was 7.4 (range, 5–9) before the latest ACL injury and 7.2 (range, 5–9) at the last follow-up. The mean PTS was 13.6° (range, 13°–14°) preoperatively and 9.2° (range, 8°–10°) postoperatively (P = .0005). The mean differential anterior laxity was 10.4 mm (range, 8–14 mm), and this significantly decreased to 2.8 mm (range, 2–4 mm) at the last follow-up. Using the Kellgren-Lawrence classification to evaluate the presence of arthritis, 1 patient was grade 1, 3 patients were grade 2, and 1 patient was grade 3.
Conclusion: Combined ACL re-revision with proximal tibial anterior closing wedge osteotomy restores knee stability and function with satisfactory clinical outcomes in patients who experience recurrent ACL ruptures with an associated increased PTS.

FM 25

Clinical and radiological long-term results after combined partial meniscus substitution using the collagen meniscal implant and ACL reconstruction – 3–7 years results

PD Dr. Michael Hirschmann, Kantonsspital Baselland, Bruderholz/CH; Dr. Leonie Keller, Kantonsspital Aarau AG/CH; Dr. Anna Hirschmann, Universitätsspital Basel, Basel/CH; Dr. Roger Berbig, SportClinic Zurich, Zürich/CH; Dr. Ursus Lüthi, SportClinic Zurich, Zürich/CH; Felix Amsler, Amsler Consulting, Basel/CH; PD Dr. Markus P. Arnold, LEONARDO – Ärzte für Orthopädie und Traumatologie, Münchenstein/CH

Introduction: The purpose was to evaluate the clinical and radiological longer-term outcomes (3–7 years) after combined medial or lateral collagen meniscus substitution (CMI) and ACI reconstruction.
Methods: 39 patients (me an age 34 ± 10 years) underwent arthroscopic CMI after subtotal medial (n = 32) or lateral meniscectomy (n = 7); prophylactic (n = 25) versus therapeutic indication (n = 14). 29 patients (63%) underwent additional procedures such as ACL reconstruction (n = 24). Follow-up consisted of IKDC score, Tegner score preinjury, preoperatively and at follow-up, Lysholm score and VAS for pain and satisfaction (follow-up rate 90%). MRI was analyzed according to the Genovese criteria. Extrusion of the meniscus was noted. Implant failure was defined as infection or mechanical failure. The minimum follow-up time was 36 months.
Results: The median Tegner score preinjury was 7 (range 3–10), it decreased preoperatively to median 3.5 (range 1–8) and nearly reached the preinjury level at last follow-up 6 (range 3–10). The mean Lysholm score before surgery was 66 ± 20 and 91 ± 8 at last follow-up. The mean flexion and extension ± standard deviation at one year follow-up was 143° ± 5° and 5° ± 1° respectively. 38.9% of patients showed a normal total IKDC score (A) and 55.6% were nearly normal (B) and 5.6% slightly abnormal (C). The mean VAS satisfaction preoperatively and at follow-up was 4.0 ± 0 and 1.6 ± 1.0. The mean VAS pain was 4.3 ± 3.2 preoperatively and at last follow-up 2.1 ± 1.8. On MRI the meniscus implant was entirely resorbed in 4 patients (21%) and in 15 (79%) partially resorbed. In 4 patients (21%) the meniscus graft was isointense, 14 (74%) were slightly hyperintense and 1 (5%) highly hyperintense. The size of the cartilage lesion was <50% in 12 patients (63%) and >50% in 7 patients (37%). 9 patients (47%) showed no signs of bone marrow edema. 10 patients (53%) showed showed signs of BME. 13 patients (68%) patients showed an extrusion of the meniscus >3 mm at last follow-up. There was no significant difference between the Tegner score, Lysholm score, VAS satisfaction and VAS pain at one year and at 3–7 years follow-up.
Conclusion: CMI showed excellent to good clinical 3–7 years results. Significant pain relief and functional improvement throughout all scores was noted. The CMI undergoes significant remodelling, degradation and extrusion in a significant number of patients.

FM 26

MPFL-reconstruction using gracilis tendon autograft in 114 knees – a mean follow-up study of 5.4 years

Dr. Philippe Tscholl, Universitätsklinik Balgrist, Zürich/CH; Dr. Florian Wanivenhaus, Universitätsklinik Balgrist, Zürich/CH; PD Dr. med. Sandro F. Fucentese, Universitätsklinik Balgrist, Zürich/CH

Introduction: Reconstruction of the medial patellofemoral ligament (MPFL) is known as an effective procedure for patellar stabilization. Results about functional outcome at mid-term follow-up are scarce. A postoperative analysis of functional outcome, subjective satisfaction and sports participation is presented.
Methods: Between 1998 and 2012, 228 MPFL reconstructions in 211 patients (85 with tibial tubercle osteotomy (TT-OT)) were performed in our institution. Ipsilateral gracilis tendon was used as standard autograft using double-bundle technique. TT-OT was performed if patellar maltracking was due to patella alta or due to rotational malalignment. Patients were invited in November 2013 to participate in a prospective outcome study by questionnaires for subjective/objective outcome, and clinical/radiographic follow-up. IRB approval was obtained.
Results: 106 patients (114 knees; 24.4 ± 9 years) agreed to participate. Questionnaires were returned for 113 knees, 77 knees were evaluated clinically and radiographically at a mean follow-up of 5.4 ± 3.1 years. 86.8% of the patients were satisfied with the postoperative result. Kujala score increased significantly from 50.6 to 75.2 points ($p < 0.01$) and in 82% of all knees. Patients with decreased Kujala score were not significantly different in terms of follow-up time, age at surgery, number of previous surgery or grade of trochlear dysplasia. 40% of the patients were able to perform more sports, and one third had to decrease their sporting activities at follow-up. There was no correlation to postoperative sports activity and grade of trochlear dysplasia. Six patients with persisting instability were found, three with patellar re-dislocation and recurrent subluxations each. Re-operation was performed in 24 patients (21.2%), mainly for hardware removal (N = 13) and loss of flexion (N = 9). If TT-OT was performed, no significant difference was found comparing pre- and postoperative Kujala score, subjective patellar instability, and subjective knee score.
Conclusion: MPFL reconstruction shows high satisfaction at a mean follow-up of 5.4 years also after failed primary surgical stabilization, and does not deteriorate in patients with a follow-up of more than 8 years. Concomitant TT-OT, when indicated, does not lead to worse outcome compared to isolated MPFL reconstruction and sports participation can be restored in most of the patients unrelated to trochlear dysplasia.

FM 27

Dynamic intraligamentary stabilization: a treatment option for acute ACL ruptures?

Dr. Sufian S. Ahmad, Bern/CH; Dr. Sandro Kohl, Inselspital Bern, Bern/CH

Background: After decades of rest, techniques for acute anterior cruciate ligament (ACL) repair have recently been re-evaluated. This is a report of a single-center experience with Dynamic Intraligamentary Stabilization (DIS) using the Ligamys® device for treatment of acute ACL rupture.
Methods: Between March 2011 and April 2012, 50 patients, median age of 26 (18–50), with acute ACL rupture underwent primary ACL repair by DIS, using the Ligamys® (Mathys, Bettlach, Switzerland) device. Patients were evaluated for laxity (instrumented measurement anterior tibial translation), stability (pivot shift), range of motion (ROM), Tegner, Lysholm International Knee Documentation Committee (IKDC) and visual analogue scale (VAS) scores over a follow-up period of 24 months.
Results: At 24 months follow-up, mean ΔAP-Translation was 0.96 ± 1.7 mm. Median (Range) IKDC, Tegner, Lysholm and VAS scores were 98 (82–100), 6 (4–9), 100 (87–100) and 10 (8–10), respectively. Pre injury Tegner activity levels were reached one year postoperatively. In this series, 9 patients (18%) required a secondary intervention (1 gross instability, 5 hypertophic scar formation with extension loss and 3 traumatic re-ruptures), 4 of these were secondary reconstructions. The screw was removed in 30 patients (60%).
Conclusion: There could be a promising aspect to this technique. Despite the fairly high rate of secondary interventions, 82% of treated patients were provided a successful chance of maintaining the ACL over the coarse of two years. Further investigations should be performed to elucidate the best candidates for the procedure, and optimization of the device is necessary.

FM 28

Reinterventionen nach banderhaltender Operationstechnik der vorderen Kreuzbandruptur (Ligamys)

Dr. Laurenz Jaberg, Orthopädie Sonnenhof, Bern/CH; Dr. Philipp Henle, Orthopädie Sonnenhof, Bern/CH; Prof. Dr. Stefan Eggli, Orthopädie Sonnenhof, Bern/CH

Zwischen 07/2009 und Dezember 12/2014 wurden an unserer Institution 467 Rupturen des vorderen Kreuzbands (465 Patienten) mit einer dynamischen intraligamentären Stabilisation (Ligamys) behandelt. Ziel dieser Studie ist eine Evaluation von Häufigkeit, Art und Zeitpunkt von Reinterventionen. Sämtliche Daten wurden prospektiv erhoben. Der erhobene Datensatz beinhaltet die Indikation zur Operation, Art und Anzahl der Reintervention, durchschnittlicher Nachuntersuchungszeitraum, Zeit zur Reintervention sowie Zeit einer allfälligen Reruptur. Der mittlere Nachuntersuchungszeitraum beträgt 653 Tage (21,8 Monate). Im Untersuchungszeitraum kam es bei den 467 operierten Kreuzbändern zu 66 (14,1%) komplikationsbedingten Reinterventionen bei 54 Patienten (11,6%). Davon musste in 18 Fällen (3,8%) aufgrund einer Reruptur oder Insuffizienz die Konversion auf eine Kreuzbandplastik erfolgen. Die Mittlere Zeitdauer bis zur Reruptur betrug 467 Tage (135–1507 Tage). In 17 Fällen erfolgte die Rekonstruktion mittels Patellarsehnentransplantat, ein Patient wurden mit einem Hamstring-Transplantat versorgt. Die Rekonstruktion erfolgte im Schnitt 571 Tage (202–1517 Tage) nach der Indexoperation. Zusätzlich erfolgten 44 (9,4%) arthroskopische Reinterventionen durchschnittlich 317 Tage (82–1016 Tage) nach Indexoperation. Davon 25 wegen eingeschränktem Bewegungsausmass und daraus resultierenden Beschwerden, 15 wegen persistierender oder neuer Meniskusläsionen sowie einer arthroskopischen Spülung bei Infektverdacht. Die mittlere Zeitdauer bis zur Reintervention betrug hier 304 Tage (max. 1016/min. 37). Je eine Reintervention erfolgte aufgrund eines oberflächlichen Wundinfektes im Bereich des Implantatlagers und eines Hämatoms. Bei 2 (0,4%) Patienten erfolgte ausschliesslich eine Kurzmobilisation in Narkose. Im gleichen Zeitraum erfolgten 82 (17,5%) elektive Implantatentfernungen. In 17 Fällen erfolgte in Kombination zur Implantatentfernung zusätzlich eine Mobilisation in Kurznarkose. Bei einer Gesamtzahl von 467 Ligamys-Versorgungen erfolgten 66 (14,1%) komplikationsbedingten Reinterventione, davon 18 (3,8%) sekundäre Rekonstruktionen bei Rerupturen oder Insuffizienz. Diese Zahlen sind vergleichbar mit den publizierten Daten zu Kreuzbandrekonstruktionen. Im selben Zeitraum erfolgten zusätzlich 82 (18%) elektive Implantatentfernungen welche sicherlich als operationsspezifische Re-Intervention, nach unserem Dafürhalten jedoch nichts als Komplikation angesehen werden müssen.

FM 29

Visual-palpatory versus fluoroscopic intraoperative determination of the femoral entry point in MPFL reconstruction: a cadaver study

Dr. Ramin Herschel, Universitätsklinik Balgrist, Zürich/CH; Dr. Anita Hasler, Universitätsklinik Balgrist, Zürich/CH; Dr. Philippe Tscholl, Universitätsklinik Balgrist, Zürich/CH; PD Dr. med. Sandro F. Fucentese, Universitätsklinik Balgrist, Zürich/CH

Background: Determination of the femoral entry-point in reconstruction of the medial patellofemoral ligament (MPFL) for patellar instability is usually performed by palpation of the anatomic landmarks. However, the accuracy of this method has not yet been investigated. Malpositioning can lead to abnormal, painful patellar kinematics and a loss of flexion. The purpose of this study was to assess the validity of the palpatory method compared to a fluoroscopically guided method using established radiological criteria and to assess the accuracy of the entry point in relation to surgical experience.
Methods: Three surgeons of varying experience defined the femoral entry point for the MPFL by palpation in ten Thiel fixated cadaveric legs. The blinded procedures were repeated three times, subjective difficulty of the determination was recorded. Results were documented by fluoroscopy on a true lateral radiograph. The accuracy was assessed by two independent, blinded observers using established radiological criteria. Surgical experience was correlated to the results and confounding or interacting variables were assessed.
Results: Mean deviation from the correct zone for the femoral entry-point was 3.5 mm (range, 0 to 18 mm). 29% of all palpatory determinations were inside the correct zone, 47% were within 5 mm distance from the correct zone, and 23% were further than 5 mm apart from the correct zone ("outliers"). No significant difference was found between surgeons of varying experience. No correlation was observed between subjective difficulty of the procedure and accuracy of determination. However, a trend was seen that for outliers (>5 mm),

the most experienced surgeon rated subjective difficulty of the procedure as moderate or high.
Conclusions: The validity of the palpatory determination alone seems to be insufficient. An inacceptable rate of outliers was observed, independent of the surgical experience. Therefore, standard intraoperative fluoroscopy is used for determination of the femoral entry point in MPFL reconstruction, in our clinic. Very experienced surgeons working without fluoroscopy by default should consider radiological support in cases of difficult palpatory determination.

FM 30

Is a valuable option to perform anterior cruciate ligament reconstruction in day case surgery? Prospective comparative non randomized monocentric study of 60 cases

Dr Alexandre Lunebourg, Hôpital Ste Marguerite, Marseille/FR; Dr Matthieu Ollivier, Hôpital Ste Marguerite/FR; Prof. Jean-Noël Argenson, Hôpital Ste Marguerite/FR; Prof. Sébastien Parratte, Hôpital Ste Marguerite/FR

Introduction: Anterior cruciate ligament reconstruction is more and more frequent with more than 100'000 surgeries per year in the United States. The rate of this surgery in day case surgery is also raising, but only few studies have reported the results of satisfaction after this procedure. Our hypothesis was that satisfaction was higher and clinical results and complications were similar for patients operated in day-case surgery compared to patients operated in conventional hospitalization. Thus, the aims of this study were to compare the satisfaction, clinical scores and complications of patients in these two groups.
Patients and Methods: 60 patients were prospectively non-randomized included in this study. 30 patients operated in day-case surgery for an isolated reconstruction of the anterior cruciate ligament were matched according to age, sex, BMI and delay from injury to operation to 30 patients operated in conventional hospitalization. The mean age at surgery was 32 years, BMI was 26 kg/m², 83% of patients were male and the delay from injury to surgery was 5 months. All the patients were operated by the same technique of reconstruction using quadrupled semitendinosus anterior cruciate ligament reconstruction with cage fixation. The same protocol of anesthesia and post-operative analgesia were used in all patients. Intra-articular drain and brace were never used. Satisfaction of patients was assed using 5 questions about the course of surgery and hospitalization. Clinical scores (IKDC and KOOS) were compared at 3 months and at 1 year. Complications were compared in the two groups.
Results: Satisfaction of patients was better in the group of day-case surgery (98% versus 88%) compared to the group of conventional hospitalization with more patients which recommended this course of surgery and hospitalization (97% versus 80%) in the group of day-case surgery. Clinical scores were not different between the two groups at 3 months and at 1 year. No readmission was necessary in the two groups, but 2 revisions were needed in the group of conventional hospitalization.
Discussion: Results of our study showed that patients operated in day-case surgery for an isolated reconstruction of the anterior cruciate ligament presented a higher rate of satisfaction compared to patients operated in conventional hospitalization with comparable clinical results at 3 months and 1 year. Outpatient unit improves satisfaction of patient.

FM 31

Open meniscus repair in total and partial horizontal meniscal lesions: a biomechanical cadaver study

Dr. Felix Waibel, Universitätsklinik Balgrist, Dättwil/CH; Dr. Arnd Viehöfer, Universitätsklinik Balgrist, Zürich/CH; Elias Bachmann, University of Zürich and ETH Zürich, Zürich/CH; Prof. Dr. Jess Snedeker, Universitätsklinik Balgrist, Zürich/CH; PD Dr. med. Sandro F. Fucentese, Universitätsklinik Balgrist, Zürich/CH

Introduction: Horizontal meniscal tears consist of a superior and inferior leaf. Those tears are often treated by partial meniscectomy due to implication of a poor healing potential, difficulties to perform the repair and potential suture failure due to shear stress between the superior and inferior leaf. Clear evidence for a specific treatment of those lesions is missing in the literature. The goal of the present study was to biomechanically analyze the sutures of those lesions via open peripheral vertical sutures.
Methods: Two groups of five medial and lateral bovine menisci each were tested: Group A with a partial artificial horizontal lesion and Group B with a total artificial horizontal lesion. These two groups were compared to a native control group. The specimen were glued on a Sawbone block and put in a fixation device in an angle so that the FShear to FCompression ratio was 0.4/3. Axial loading was performed using a universal testing machine. 1000 cycles between 0N and 45N were applied on a displacement-controlled basis, simulating partial weight-bearing of 15 kg according to our local aftertreatment protocol (LAP). Load-displacement was recorded using TestXpert 10 software. High-resolution images were taken to measure slippage (cycle 0 and 1000, load 0N and 45N). Construct stiffness was calculated for all tested samples. One sample had to be ruled out due to technical failure.
Results: Displacement occurred in both groups, especially after 1000 loaded cycles, with more displacement in the total tear group. However, no suture failure or pullout occurred in any group after 1000 cycles. The stiffness of the partial group was closer to the native than the total tear.
Conclusion: The construction seems to be stable enough, especially in the partial tear group, so that open peripherical suture can be considered.

FM 32

Outcome after mobilization with femoral and sciatic nerve block for knee stiffness

Dr. Florian Wanivenhaus, Universitätsklinik Balgrist, Zürich/CH; Dr. Philippe Tscholl, Universitätsklinik Balgrist, Zürich/CH; Dr. José Aguirre, Universitätsklinik Balgrist, Zürich/CH; René Giger, Universitätsklinik Balgrist, Zürich/CH; PD Dr. med. Sandro F. Fucentese, Universitätsklinik Balgrist, Zürich/CH

Introduction: Stiffness following knee surgery is a frustrating complication and a significantly disabling problem. This study aimed to evaluate the effectiveness of an intermittent femoral and sciatic nerve block combined with an in-house physiotherapy protocol as a treatment for postsurgical stiffness of the knee.
Methods: Sixty-eight patients with a stiff knee after all types of standardized knee surgeries were identified. Stiffness was defined as a flexion deficit or extension lag at the routine three months follow-up (FU) that negatively impacted daily function of the knee. The patients were evaluated for passive knee flexion and extension at several time-points starting preoperatively and were followed up until a mean of 16.6 months post mobilization intervention. The sciatic and femoral nerve catheters were activated 1 hour prior to each physiotherapy session, which was performed twice a day. This was supported by a continuous passive range of motion machine that was used three hours a day.
Results: The mean time from admission to the stop of the catheters and duration of stay was 3.9 (range, 1–8) days and 7 (range, 2–19) days respectively. The overall mean flexion increased significantly between pre-treatment (74°) and at discharge (109°, $p < 0.01$). No significant difference of mean flexion at six weeks FU compared to the flexion at discharge (108°, $p = 0.764$) but a significant increase at the last FU (120°, $p < 0.01$). The overall mean knee extension lag decreased significantly between pre-treatment (5°) and at discharge (0.4°, $p < 0.01$). There was no significant increase of mean extension lag between the last FU (1°, $p = 0.2$) and at discharge. The subgroup analysis for arthroplasty patients versus all other patients demonstrated that a significant decreased mean flexion at the time of catheter stop (115° vs 125°), at six weeks (99° vs 117°) and at the last FU (110° vs 129°) can be observed ($p < 0.01$). A significant increased mean extension lag can be observed at the discharge time-point in the arthroplasty group compared to the rest ($p < 0.01$). There was no significant difference in the ROM for all time-points between the arthroscopy group and patients that had surgery for patellofemoral disorders. Eleven patients underwent re-surgery for persisting stiffness.
Conclusion: This novel in-house physiotherapy protocol with continuous knee mobilization is a valuable alternative to manipulation under anesthesia with similar earlier gain of ROM but less loss of ROM at FU.

FM 33

Effect of mechanical pressure and coating with tricalcium phosphate granules on the experimental healing of tendon transfer in rabbits

Dr. Marco Germann, Universitätsklinik Balgrist, Zürich/CH; Dr. Karl Wieser, Universitätsklinik Balgrist, Zürich/CH; Dr. Christoph Agten, Universitätsklinik Balgrist, Zürich/CH; PD Dr. med. Sandro F. Fucentese, Universitätsklinik Balgrist, Zürich/CH; Dr. Katja Nuss, Vetsuisse Faculty, University of Zurich, Zürich/CH; Prof. Dr. Jess Snedeker, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. med. Christian Gerber, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Dominik Meyer, Universitätsklinik Balgrist, Zürich/CH

Introduction: Tunnel widening is a radiographically frequent sequel of cruciate ligament reconstruction with hamstring tendons with unknown clinical consequences. The aim of this study was to investigate the effect of mechanical pressure and coating with tricalcium phosphate granules (TCP) on a tendon graft regarding tunnel size in an animal model.
Methods: In 18 left knees of white New Zealand rabbits the proximal extensor digitorum tendon was transferred into a drill hole parallel to the joint line of the knee. In 9 rabbits, the doubled tendon was coated with TCP granules and mechanically pressed before insertion into the drill hole. 9 rabbits served as control group (CG) without further treatment of the doubled tendon before insertion. In the treatment group (TG), the size of the tendon graft was determined before and after treatment (TCP/press) while in the CG the graft size was only determined before insertion into a drill hole of according diameter. All animals were sacrificed 84 days postoperatively. Micro-CT was performed in all animals. Height and width of the bone tunnel were measured and determined as diameters of an ellipse. The area of this ellipse was calculated as measure for the cross section of the bone tunnel. Measurements were taken at both ends of the bone tunnel (entry/deep) as well as in its middle.
Results: One animal of the CG was excluded from the study, because the tendon graft was outside the bone tunnel while the tunnel was fully consolidated. The mean graft diameter was 2.9 mm in the CG. In the TG it was 2.9 mm before and 2.5 mm after treatment. The mean drill hole diameters and areas were 2.9 mm and 6.7 mm^2 in the CG and 2.4 mm and 4.7 mm^2 in the TG. The mean areas of the bone tunnel were 5.7 mm^2, 5.2 mm^2 and 4.1 mm^2 (entry/middle/deep) in the CG and 4.2 mm^2, 3.7 mm^2 and 2.6 mm^2 in the TG.
Conclusion: Mechanical pressure on a tendon graft allows to reduce the water content of the tendon and thus to create smaller holes for its insertions. The size of the bone tunnels at sacrifice compared to the initial drill holes is almost identical regardless if mechanical pressure was applied. Therefore, mechanical pressure may be useful to insert the same tendon into a smaller bone canal, thereby preserving bone and creating a tighter fit at the same time.

FM 34

Cartilage tissue engineering from nose to knee: 12-months results of a phase 1 clinical trial

Dr. Marcus Mumme, Universitätsspital Basel, Basel/CH; PD Dr. Andrea Barbero, University of Basel/CH; Anke Wixmerten/CH; Dr. Sylvie Miot, University Hospital Basel, Basel/CH; Oliver Bieri/CH; Dr. Anna Hirschmann, Universitätsspital Basel, Basel/CH; Ueli Studer/CH; Thomas Schwamborn/CH; Prof. Dr. Ivan Martin, University Hospital Basel, Basel/CH; Prof. Dr. Marcel Jakob, Universitätsspital Basel, Basel/CH

Introduction: As compared to commonly used cell based treatments for articular cartilage repair, grafting of cartilage tissues, engineered in vitro to reach a mature stage, could result in more durable repair. To reduce the variability in the quality of the engineered tissue grafts, nasal chondrocytes were used as a cell source with reproducible chondrogenic capacity. The purpose of this phase-1 study was to demonstrate safety and feasibility of the procedure. Preliminary indications on efficacy after 12 months are also presented.
Methods: Ten patients with symptomatic, post-traumatic full-thickness cartilage lesions (2–8 cm^2) on the femoral condyle/ trochlea were treated. Patients underwent nasal septum cartilage biopsy in an outpatient procedure. Autologous nasal chondrocytes were isolated, expanded, seeded and cultured in collagen sponges (Chondrogide®, Geistlich) according to Good Manufacturing Practice (GMP) regulations. After four weeks production, the engineered nasal cartilage graft was implanted via mini-arthrotomy. Patients were followed up radiologically by MRI (MOCART score), delayed Gadolinium Enhanced MRI (dGEMRIC, for assessment of glycosaminoglycans content) and clinically (IKDC score).
Results: No complications occurred by nasal cartilage biopsying or implantation of the engineered tissues, 6 patients with 8 cartilage defects reached 12 months follow up so far. One patient with 1 defect partially lost the graft due to new sports injury and was excluded from analysis. The MOCART score 12 months post surgery was 32.5 (5–55). The dGEMRIC revealed a relative ΔR1 of 1.50 (0.78–2.17). The IKDC pre-surgery and 12 months post-surgery was 58.6 and 78.6 respectively.
Conclusion: These early results demonstrate safety and feasibility of the method and indicate that engineered nasal cartilage grafts can participate to the repair of articular cartilage defects in the knee. The mean relative ΔR1 of 1.50 (1.0 for native cartilage) suggests that hyaline repair tissue can be achieved, possibly to a higher extent than MACT (2.18, Trattnig+, 2008) or ACT (2.40, Trattnig+, 2007). Our results demonstrate safety and feasibility of the method and indicate that patients can benefit from this therapy. This study opens a new approach in biological cartilage regeneration, based on engineering of mature cartilage tissues using autologous nasal chondrocytes.

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FM 35

Ilio-sacral stabilization of sacral jumper's fractures using the AO-Spine fracture system: a novel surgical technique

Dr. Alexander Mameghani, Kantonsspital Baden, Baden/CH; Prof. Dr. Stefan Schären, Universitätsspital Basel, Basel/CH; Prof. Dr. Bernhard Jeanneret, Universitätsspital Basel, Basel/CH

Introduction: Jumper's fractures are severe dissociation injuries of the spinopelvic junction. These U-shaped fractures are due to an axial trauma. The treatment of these fractures associated with neurological complications includes emergency decompression combined with reduction and stabilization of the fracture-dislocation. Usually, stabilization from L4 or L5 to the ilium combined with decompression of the spinal canal is advocated, thus fusing one or two additional healthy lumbar motion segments. We report on three patients with jumper's fractures, in whom we successfully performed a posterior decompression and open stabilization from S1 to the ilium, therefore sparing the motion segments L4/S1.
Methods: 3 patients (40, 45 and 49 years old) had been admitted to the emergency room after they attempted suicide and jumped from a greater height. All three had a jumper's fracture with fragments into the sacral canal and epidural hematoma. Indication for emergency decompression was present. In prone position a midline incision was performed and decompression of the sacral canal was achieved. After decompression bilateral long monoaxial USS II screws were placed into the ilium. Schanz' screws from the USS fracture system were then introduced bilaterally in S1. The rods were rigidly mounted to the monoaxial ilium-screws. Fracture reduction and stabilization was performed under fluoroscopic control with the same manoeuvre as used for reduction of lumbar burst fractures. Fracture reduction and healing was examined with postoperative CT scan and controlled after 3 and 9 month.
Results: Bony healing was achieved in all three patients. In all 3 cases implant removal was performed after bony healing was proved as seen in computed tomography. At 1 year follow-up, neurological exam was normal in 2 patients. 1 patient still had persistent incomplete bladder and bowel function disorders. All patients were able to walk without assistance.
Conclusion: Ilio-sacral stabilization seems to be a reliable way of achieving reduction and bony healing in jumper's fractures. The reduction manoeuver is the same as described by Magerl and later on by Dick for lumbar burst fractures. As the lumbosacral motion segments (L4/5 and L5/S1) remain untouched, this technique offers the advantage of sparing important motion segments of the lumbar spine, thus being less invasive than the usually advocated techniques. However, this technique only is possible, if the segment L5/S1 is intact.

FM 36

In-screw cement augmentation for iliosacral screw fixation in posterior ring pathologies with insufficient bone stock

Dr. Matthias König, UniversitätsSpital Zürich, Zürich/CH; Sebastian Hedinger/CH; Dr. Jürgen Schmitt, UniSpital Zürich, Zürich/CH; Dr. Thorsten Jentzsch, Universitätsklinik Balgrist, Zürich/CH; Dr. Kai Sprengel/CH; Prof. Dr. Clément Werner, UniversitätsSpital Zürich, Zürich/CH

Introduction: Minimal invasive screw fixation is common for treating posterior pelvic ring pathologies, but lack of bone quality may cause anchorage problems. The aim of this study was to report in detail a new technique combining iliosacral screw fixation with in-screw cement augmentation (ISFICA).
Material and Methods: The patient was put under general anesthesia and placed in the supine position. A K-wire was inserted under inlet-outlet-view to guide the fully threaded screw. The screw placement was followed through the K-wire in adequate position. Cement was applied through a bone filler device, inserted at the screwdriver. The immediate control of cement distribution, accurate screw placement and potential leakage were obtained via intra-operative CT scan. 20 consecutive patients treated with ISFICA were included in this study. The mean age was 74.4 years (range 48–98). Screw placement, possible cement leakage and screw positioning were evaluated via intraoperative CT-scan. Postoperative neurologic deficits, pain reduction and immediate postoperative mobilization were clinically evaluated.
Results: 26 screws were implanted. All patients were postoperatively, instantly mobilized with reduced pain. No neurologic deficits were apparent postoperatively. No cement leakage occurred. One breach of the iliac cortical bone was noted due to severe osteoporosis. One screw migration was seen after one year, two patients showed iliosacral joint arthropathy, which led to screw removal.
Conclusion: ISFICA is a very promising technique in terms of safety, precision and initial postoperative outcome. Long-term outcomes such as lasting mechanical stability or pain reduction and screw loosening despite cement augmentation should be investigated in further studies with larger patient numbers.

FM 37

Normative values for the L5 incidence angle and its correlation with other spino-pelvic parameters: a database of 147 asymptomatic subjects

Dr Dennis DOMINGUEZ, Geneva University Hospitals, Geneva/CH; Dr Antonio Faundez, Geneva University Hospitals/CH; Dr Hugues Demezon, CHU Pellegrin/FR; Prof. Jean Charles Le Huec, CHU Pellegrin/FR

Introduction: Sagittal balance analysis has become a mandatory step before any therapeutic decision related to lumbo-sacral pathologies, especially if surgical. Determination of pelvic parameters such as Pelvic Incidence (PI) is paramount. In case of lumbosacral transitional vertebrae, or spondylolisthesis with dome shaped sacrum, classical measurement of PI is not reliable. Upper endplate of L5 is less subject to anomalies, but no normative values for pelvic and spinal parameters based on L5I have been described yet. The purpose of this study was to provide normative data of the L5 incidence angle (L5I) and their correlation with standard spino-pelvic parameters.
Methods: Prospective mono centric study. The protocol was approved by the ethics committee of our institution. 147 asymptomatic volunteers underwent an EOS low-dose full spine Xray (EOS Imaging, Paris, France). SterEOS software (EOS Imaging) was used to obtain 3D full spine reconstructions. L5I was measured. Normative data of spino-pelvic parameters were calculated. We estimated statistical correlations between: L5I and Pelvic Incidence, and L5I with L1-L5 lordosis. ODI score and VAS were obtained as well.
Results: L5I, L5 tilt, L5 slope and L5% of PI mean values were respectively 22.43, 4.65, 17.73 and 40.72. Pearson correlation between L5I and pelvic incidence was 0.83, L5I and lordosis L1-L5 was 0.62. A mathematical relationship between L5I and lordosis L1-L5 was obtained: Lordosis L1-L5 = 0.67 * L5I + 30.7 ($p < 0.05$). ODI and VAS showed that patients represent an asymptomatic population.
Conclusion: This study is the first to provide functional status for an asymptomatic population as well as spino-pelvic parameters. We propose L5I as a new spino-pelvic parameter. L5I is highly correlated with S1 incidence. The normative values provided in this study will help to control peri-operatively the lordosis restoration for patients with lombo-sacral variations.

FM 38

Does pain relief by CT-guided indirect cervical nerve root injection with local anesthetics and steroids predict pain relief after decompression surgery for cervical nerve root compression?

Dr. Alexander Antoniadis, Uniklinik Balgrist, Zürich/CH; PD Dr. Mazda Farshad, Universitätsklinik Balgrist, Zürich/CH; Dr. Tobias Dietrich, Uniklinik Balgrist/CH

Introduction: The relation of pain relief by a new developed CT-guided indirect cervical nerve root injection with local anesthetics and steroids to surgical decompression as treatment of single level cervical radiculopathy is not clear. This retrospective study aimed to illuminate the immediate and 6-week post-injection effect to the short and long term outcome after surgical decompression.
Methods: Patients (n = 39, age 47 ± 10 years)) who had underwent CT-guided indirect injection with local anesthetics and steroids as initial treatment of single cervical nerve root radiculopathy and who subsequently needed surgical decompression were included retrospectively. Pain levels (VAS scores) were monitored before, immediately after and 6 weeks after injection (n = 31), as well as 6 weeks (n = 38) and in mean 25 months (SD±12) after surgical decompression (n = 33). Correlation analysis was performed to find potential associations of pain relief after injection and surgery to investigate the predictive value of post injection pain relief.
Results: There was no correlation between immediate pain relief after injection (–32% ± 27%) and 6 weeks after (–7% ± 19%), ($r = –0.02343$, $p = 0.900$). There was an association by tendency between immediate pain relief after injection and post-surgical pain relief at 6 weeks (–82 ± 27%), ($r = 0.28$, $p = 0.08$). Pain relief at FU remained high with –70 ± 21% and was correlated with the immediate pain amelioration effect of injection ($r = 0.37$, $p = 0.032$).
Conclusion: The amount of immediate pain relief after indirect cervical nerve root injection is associated with the amount of pain relief achieved at long term after surgical decompression of single level cervical radiculopathy.

FM 39

The prognosis of L5 radiculopathy after reduction and instrumented fusion of adult isthmic high-grade lumbosacral spondylolisthesis and the role of multimodal intraoperative neuromonitoring (MIOM)

Dr. Ralph Schär/CH; Dr. Martin Sutter/CH; PD Dr. Anne F. Mannion, Schulthess Klinik, Zürich/CH; Dr. Andreas Eggspühler/CH; Dr. Dezsö Jeszenszky, Schulthess Klinik/CH; Dr. Tamas F. Fekete/CH; Dr. Frank S. Kleinstück/CH; Dr. Daniel Haschtmann/CH

Introduction: Iatrogenic L5 nerve root injury is a common complication of reduction of isthmic high-grade spondylolisthesis (HGS). However, the clinical presentation and prognosis as well as its impact on patient-rated outcome have never been analysed systematically and the role of multimodal intraoperative neuromonitoring (MIOM) is largely unknown.
Methods: Clinical and radiographic data from consecutive patients who underwent reduction and instrumented fusion of HGS between 2005–2013 in a single center were analysed. The multidimensional Core Outcome Measures Index (COMI) was completed before and 1 year after surgery. MIOM with transcranial motor evoked potentials (MEP) and continuous electromyography (EMG) of index muscles was carried out.
Results: The data from 17 patients (13f, 4m; mean (± SD) age 26.5 (±9.2) years) with a mean radiographic follow-up of 19 (range 3 to 48) months were included. Mean L5-S1 slip was 72% (±21%), which was reduced to 19% (±13%). After 1 year, COMI improved from 6.7 ± 1.7 to 3.7 ± 3.1, leg pain from 5.2 ± 3.1 to 2.3 ± 3 and back pain from 6.2 ± 1.9 to 3.4 ± 2.6. In 5 patients (29%), an incomplete L5 motor deficit occurred: 2 suffered a moderate, and 3 a mild paresis. 4 patients fully recovered after 3 months, and 1 patient was lost to follow-up. 25 intraoperative MIOM alerts were recorded in 15 of the 17 procedures (88%). Based on intraoperative signal recovery, MIOM predicted a new neurological deficit in just 1 out of 17 patients. In respect of new L5 motor deficits postperatively, MIOM had a sensitivity of 20% and a specificity of 100%. Related to final outcome with all followed up patients (N = 16) recovering by 3 months, MIOM specificity remained at 100%.
Conclusion: Reduction and instrumented fusion of HGS showed a satisfactory outcome. The rate of transient L5 palsy was relatively high. However, the prognosis of this deficit was favorable and full recovery was achieved after 3 months in all followed up cases. MIOM alerts occurred in 88% of the procedures and thereby possibly prevented permanent neurological deficits. Intraoperative recovery of deteriorating MIOM signals cannot predict transient neurological deficits.

FM 40

Two-level anterior cervical discectomy with fusion: does anterior cervical plate fixation influence radiographic and patient-rated outcomes?

Dr. Tamas F. Fekete/CH; PD Dr. Anne F. Mannion, Schulthess Klinik, Zürich/CH; PD Dr. François Porchet/CH; Dr. Serge Marbacher/CH; Dr. Frank S. Kleinstück/CH; Dr. Dezsö Jeszenszky, Schulthess Klinik/CH; Dr. Daniel Haschtmann/CH; Dr. Jan-Karl Burkhardt/CH

Introduction: We aimed to identify technique-related factors influencing radiographic and patient-rated outcomes after two-level anterior cervical discectomy with fusion (ACDF) using either cage or autologous bone, with or without anterior plate fixation (APF).
Methods: This single center study was nested within the Eurospine Spine Tango data acquisition system. Inclusion criteria: consecutive two-level ACDF patients (2004–2012) presenting with signs of degenerative cervical radiculopathy or myelopathy. Before and 12 month postoperatively, patients completed the multidimensional Core Outcome Measures Index (COMI), rated the Global Treatment Outcome (GTO) and satisfaction with care. Cervical lordosis and segmental height were assessed radiographically before, immediately postoperatively, and at last follow-up (18.2 ± 13.3 months).
Results: 144 consecutive patients (112 with APF) were included. The use of APF versus stand-alone methods was associated with significantly increased segmental height (2.6 ± 2.6 mm vs. 1.5 ± 2.3 mm, $p = 0.03$) and preservation of lordosis (2.8° vs. –1.7°, $p < 0.0001$) at LFU, with comparable clinical outcome (COMI score reduction ≥3.3-point). Multiple regression controlling for potential confounders revealed that APF ($p = 0.0008$) and cage ($p = 0.004$) were associated with greater segmental height at LFU; APF was associated with a greater lordosis angle at LFU ($p < 0.0001$). Greater increase in segmental height at LFU ($p = 0.02$) was associated with a better GTO.
Conclusions: Adding APF was associated with greater segmental height and preservation of lordosis in two-level ACDF, especially using bone autograft, but also for cage. Clinical outcome was comparable for all groups. Though the surgical technique per se did not determine clinical outcome, patients achieving a greater segmental height difference showed a significantly better GTO.

FM 41

Survival rate after repeat surgery of chordomas of the cervical spine including the cranio-vertebral junction

Dr. Dezsö Jeszenszky, Schulthess Klinik/CH; Dr. Peter Obid/CH; Dr. Robert Hunyadi/CH; Dr. Daniel Haschtmann/CH; Dr. Frank S. Kleinstück/CH; Dr. Tamas F. Fekete/CH

Introduction: Chordomas rarely metastasize but due to the high local recurrence rate, despite surgical resection and/or radiation therapy, prognosis is poor. There is a paucity of literature regarding the outcome of treatment of recurrent chordomas. The purpose of this study was to report on survival rate and complications in patients treated with chordoma remnants with/without tumor recurrence at the cranio-cervical junction or in the cervical spine.
Methods: 24 patients, referred to our department with chordoma remnants (Rc-group; 7 cases) or recurrent chordomas (RRc-group; 17 cases) were reviewed retrospectively between 1999 and 2012 (12 men and 12 women, aged 5 to 86 (mean 44.3) years). The chordomas were located at the cranio-cervical junction (N = 13), mid-cervical level (N = 9) and the low-cervical spine (N = 2). All patients underwent single- or multi-staged piece-meal tumor removal and instrumentation if necessary. Postoperatively, 4 patients received adjuvant proton beam radiation therapy (mean dose, 69.2 CGE) and 12 patients, combined photon- and proton beam radiation therapy (mean dose, 74.19 CGE). Medical and radiological follow-up took place on average 37.5 (4 to 102) mo after surgery. Survival rates were evaluated with Kaplan-Meier-plots.
Results: Gross total tumor removal was achieved in 17 cases, subtotal resection in 3, and uncertain degree of resection in 3 cases; in 1 case, for palliative reasons, partial excision was carried out. Early complications were CSF leak in 7 patients, meningitis in 1, haematoma evacuation in 3 (due to neurological deficit). Dehiscence of the pharyngeal wall at the site of incision was the most common long-term complication (7 cases). No instances of instability were observed. The 5-year progression-free survival rate was 72.6%.
Conclusion: In patients who have undergone previous chordoma resection surgery, gross total tumor removal is feasible, even at the cranio-cervical junction. With the combination of adjuvant single proton- or single proton plus photon beam radiation therapy, a survival rate can be achieved that is similar to that reported in the literature following first time chordoma removal.

FM 42

Human intervertebral disc stiffness correlates better with the Otsu threshold of its axial T2 map than with clinical classifications

PD Dr. Lorin Michael Benneker, Inselspital Bern, Bern/CH; Dr. Ghislain Maquer/CH; Dr. Vaclav Brandejsky/CH; Prof. Dr. Philippe Zysset/CH

Introduction: Degenerative intervertebral disc (IVD) disease represents a major health issue in quality of life and both direct/indirect health care costs. A degeneration assessment using clinical qualitative MRI (magnetic resonance imaging) or T1, T2 or T2* quantitative MRI is possible. However, existing methods are unspecific and depend on operator's experience and latest grading systems are too complicated for clinical use. Moreover, low-back pain is related to abnormal intervertebral motions thus, this work aims to define an objective criterion for degeneration, based on axial T2 maps and reflecting the IVDs' mechanics.
Methods: 14 spinal units were extracted from 6 human lumbar spines (63–89 y). Posterior elements gFree endplates of the surrounding vertebrae were embedded in PMMA. T1 and T2 weighted anatomical images in axial, sagittal and coronal planes as well as axial T2 mapping of the samples were produced using a 3T TRIO System (Siemens) as in [Watanabe, 2007]. The specimens' degeneration was evaluated with 3 grading systems (Thompson, Benneker, Watanabe). Mean, standard deviation (SD) and Otsu threshold (T OTSU) were computed for each map in IVD, nucleus (NP), annulus (AF) and anterior, posterior, left and right regions of the AF. Otsu is a histogram-based segmentation method to compute automatically the optimal threshold that maximizes the separability of two classes of values. T2 mean is related to water content, SD and T OTSU to its homogeneity usually assessed subjectively by the clinicians. Quasi-static axial compression, torsion, lateral bending, flexion and extension tests were performed on each IVD via Spine tester device [Gédet, 2007] and stiffnesses were computed from the load-deflection curves.
Results: The grading systems correlated significantly with each other (Th/Be: $R2 = 0.84$, Th/Wa: $R2 = 0.73$), with compression and torsion stiffnesses. TOTSUAF and TOTSUPostAF correlated significantly with Thompson ($R2 = 0.43$ and $R2 = 0.37$) and all stiffnesses. NP measures, age, height, area and stiffnesses showed no correlation.
Conclusion: The classifications and stiffnesses correlates if the whole IVD is involved in the loading (compression, torsion). Our results suggest that the AF dominates the quasi-static mechanical behaviour of the IVD, especially its posterior part in flexibility tests. T OTSU is clearly a better candidate than T2 mean and SD for objective degeneration assessment.

FM 43

A combined cellular and biomaterial approach for the restoration of disc height and prevention of degeneration in discs with annular defects

PD Dr. Lorin Michael Benneker, Inselspital Bern, Bern/CH; Dr. Zhen Li/CH; Dr. Tatjana Pirvu/DE; Prof. Sebastien Blanquer/NL; Prof. Dirk Grijpma/NL;Prof. Mauro Alini/CH; Dr. David Eglin/CH; Dr. Sibylle Grad/CH

Introduction: An annulus fibrosus (AF) repair method that provides immediate closure of the AF rupture, restores the disc height, and prevents further disc degeneration by enhancing self-healing capacities is an unmet clinical need. In this study, a poly(trimethylene carbonate) (PTMC) scaffold seeded with human bone marrow derived mesenchymal stem cells (MSCs) and covered with a poly(ester-urethane) (PU) membrane was assessed for AF rupture repair in a bovine organ culture annulotomy model under dynamic load.
Methods: PTMC scaffolds in the shape of a truncated cone (2x3x4 mm, pore size 450 µm) were prepared by stereolithography. Annulotomy was performed in caudal bovine discs and PTMC scaffolds were press-fitted into the defects. Scaffolds were imbibed with fibrin gel (± MSCs) and were covered with a PU membrane which was sutured onto the adjacent AF. After 7 days of pre-culture, sinusoidal dynamic load was applied on discs (0–0.1 MPa, 0.1 Hz, 3h/d for 7d) using an organ culture bioreactor. Non-loaded discs and discs with empty defects served as controls. Outcomes included histology, disc height measurement, and gene expression analysis of implanted MSCs and host disc cells.
Results: PTMC scaffolds remained stable within the AF defect for up to 14 days, and no protrusion of nucleus pulposus (NP) was observed. The disc height was maintained after mechanical loading and recovery, while in absence of the scaffold/membrane, the disc height was significantly reduced ($p < 0.001$). Discs implanted with MSC-containing scaffolds showed trends toward up-regulation of type I

collagen, type II collagen and aggrecan gene expression in the AF tissue next to the scaffold. In mechanically loaded discs, implantation of MSCs resulted in significant down-regulation of MMP13 expression in adjacent AF cells ($p < 0.001$). The implanted MSCs could still be identified and showed up-regulation of type V collagen (potential AF marker) expression after 14 days of culture in the AF defect.
Discussion: Designed PTMC implants, combined with sutured PU membrane, restored the disc height of annulotomized discs and prevented protrusion of NP after mechanical load. Furthermore, MSCs could positively modulate the native disc tissue and may decelerate further degeneration by up-regulating anabolic and down-regulating catabolic gene expression in host disc cells. In conclusion, organ culture data indicate that this combined cellular and biomaterial approach shows great potential for AF rupture repair.

FM 44

Clinical evaluation of a novel radiolucent CF/PEEK pedicle screw system – early experience in degenerative cases

Dr. Markus Rühli, Klinik Hirslanden, Zürich/CH

Introduction: This study presents the preliminary results of the very first implantation of carbon screws in transpedicular fusion in Switzerland. Artefacts from metallic devices often hamper the postoperative evaluation of the onset of spinal diseases. In particular, the exploration of the neural structures may be challenging. This study evaluated the clinical performance of a novel Carbon/PEEK pedicle screw system, an original Swiss development.
Methods: The objective was to prospectively collect outcome information on ten consecutive patients suffering from symptomatic degenerative disc disease or degenerative spondylolisthesis requiring one or multi-level spinal fusion with instrumentation and therefore receiving the icotec Carbon/PEEK pedicle system and icotec Carbon/PEEK cages. Primary study endpoint was overall fusion rate and rate of complications as well as rate of subsequent surgical interventions were selected as secondary endpoints. Oswestry Low Back Pain Disability scores (ODI) and Visual Analogue Scale score (VAS) on low back, leg and buttock pain as well as patient's satisfaction scores were collected for every patient.
Results: After six months no pseudarthrosis was found. For the first six consecutive patients preoperative ODI was 54.7 (S.D.13.7) which was reduced to 28 (S.D.16.4) after six months. VAS scores for low back pain was reduced from 72 (S.D.35.8) to 8 (S.D.5.8) after six months and VAS scores for leg and buttock pain decreased from 63.0 (S.D.35.6) to 9.0 (S.D.7.4). Overall patient satisfaction VAS lumbar score was 6 (S.D. 8.5) after three months and further decreased to 2.5 (S.D.5.0) after six months. Asymptomatic screw loosening was found in two patients.
Conclusion: Those early clinical outcome results compare well to other series reported in literature assessing instrumented spinal fusion outcomes. The use of CF/PEEK composite pedicle screws reduced artifacts in CT and especially MR imaging. This may facilitate the postoperative evaluation of spinal structures, postoperative or late complications and assessing the onset of spinal disease and implant failures. Screw positioning and screw loosening can now in detail be analyzed by MRI, therefore additional CT investigation in these cases may no longer be necessary.

FM 45

Is the Core Outcome Measures Index (COMI) as responsive as the SRS-22 for the assessment of outcome in adult spinal deformity?

PD Dr. Anne F. Mannion, Schulthess Klinik, Zürich/CH; Alba Vila-Casademunt/ES; Montse Domingo-Sàbat/ES; Sarah Wunderlin/CH; Dr. Ferran Pellisé/ES; Dr. Emre Acaroglu/TR; Dr. Ahmet Alanay/TR; Dr. Fracisco J. Pérez-Grueso/CH; Dr. Ibrahim Obeid/FR; Dr. Frank S. Kleinstück/CH

Introduction: The Core Outcome Measures Index (COMI) is a brief instrument for assessing the main outcomes of importance to back patients (pain, function, symptom-specific well-being, quality of life, disability). However, in specific pathologies, it might be expected to be less responsive than a disease-specific instrument. In patients with adult spinal deformity, we compared the performance of COMI with the widely accepted SRS-22 questionnaire.
Methods: At baseline and 12 mo after nonoperative (N = 97) and operative (N = 49) treatment, 146 patients (123 F, 23 M) completed the following: COMI, SRS-22, Oswestry Disability Index (ODI) and SF-36 PCS. At 12 mo, patients also indicated on a 15-point Likert-scale how their back problem had changed relative to one year ago (= external criterion for treatment success).
Results: Baseline values for the COMI showed significant ($p < 0.0001$) correlations with SRS-22 subtotal ($r = -0.86$), ODI ($r = 0.85$), and SF-36 PCS ($r = -0.81$) scores. The correlations between the external criterion of treatment success and change scores (baseline to 12 mo) for the different instruments were as follows: COMI, $r = 0.52$; SRS-22 subtotal score, $r = -0.50$; ODI, $r = 0.50$; SF-36 PCS, $r = -0.34$ (each $p < 0.0001$). The SRS-22 satisfaction subscale at 12 mo FU showed a slightly higher correlation with the change score for COMI ($r = 0.47$) than for SRS-22 subtotal score ($r = -0.35$), ODI ($r = 0.37$) or SF-36 PCS scores ($r = -0.35$) (each $p < 0.01$).
Conclusion: COMI scores correlated strongly with the scores on the SRS-22, suggesting good construct validity. With either "change in back problem" or the SRS-22 "satisfaction with treatment results" serving as external criteria, COMI showed similar external responsiveness to SRS-22. The COMI seems to be well able to detect important change in adult spinal deformity. It has the added benefit of facilitating outcome comparisons with other spinal pathologies (useful in Spine registries) and reducing the response burden for the patient.

FM 46

The subtalar vertical angle: measurement and reliability using weight bearing CT scans

Lena Siegler, Kantonsspital Baselland/CH; Dr. Nicola Krähenbühl, Kantonsspital Baselland, Basel/CH; Lilianna Bolliger, Kantonsspital Baselland/CH; Prof. Dr. Beat Hintermann, Kantonsspital Baselland, Liestal/CH; PD Dr. Markus Knupp, Kantonsspital Baselland/CH

Introduction: Up to 60% of patients with osteoarthritis of the ankle joint develop a tilt of the talus with further progression. The configuration of the subtalar (ST) joint, in particular the posterior facet, might be one reason for this observation. The subtalar vertical angel (SVA) was introduced recently to distinguish between varus/valgus configurations of the posterior facet. However, the measurements were done on a healthy cohort. Further, the reliability is unknown. The aim of this study is I) to assess the SVA in patients with an asymmetric ankle arthritis and II) to assess its reliability.
Methods: 60 patients could retrospectively be included. Four groups were defined according to the type of ankle osteoarthritis: Varus and valgus ankles were distinguished into ankles with a tilted talus (incongruent) and ankle without tilting of the talus (congruent). A group of 20 patients with a healthy hindfoot were used as controls. Using the center of the heel as a pivotal point, the axis between the center of the heel and the basis of the second metatarsal was rotated 5°, 10° and 20° in the axial plane (medial and lateral). For each plane, three coronal slides of the posterior facet of the ST joint were identified (middle, anterior, posterior). Each slide was assessed concerning the SVA. 120 out of 1260 slides were evaluated three times to determine the reliability.
Results: Regarding the relative values of the SVA, no significant difference was seen for the middle, anterior or posterior plane. The same was seen after rotating the axis medial or lateral. Referring to the middle plane (0° rotation), the overall mean of the SVA was 99.2° (range 72.1–120.2). The varus groups (incongruent and congruent) had significantly lower values than valgus groups. The SVA of the control group was in between. A valgus-varus-varus configuration was mostly seen for arthritic varus ankles, while a varus-varus-varus configuration was usually seen in arthritic valgus ankles. The inter- and intra-observer reliability was good (intra-observer = 0.99, inter-observer = 0.98).
Conclusion: The SVA provides a reliable and consistent method to assess varus/ valgus configuration of the posterior facet of the ST joint. Higher SVA values were seen for valgus ankles, while varus ankles had lower values. Our data suggest that the ST joint cannot fully compensated the deformity of the ankle joint and might be a risk factor for the progression of the osteoarthritic process.

FM 47

Analysis of inter-segment coordination along with joint angulations – a more elaborative perspective to study kinematics in ankle joint

Swati Chopra, Centre Hospitalier Universitaire Vaudois and University of Lausanne, geneva/CH; Dr Julien Favre, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne/CH; PD Dr Xavier Crevoisier, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne/CH

Introduction: Joint kinematic provides information about the mobility in foot and ankle. So far, it has been commonly assessed by measuring amplitude of joint rotation, using cameras or sensors. This method describes the degree of movement occurring at a joint however it does not explain, how the two segments coordinate to

perform the movement. This information of foot segment coordination is significant to understand the compensatory movement patterns. The phase space relation between two segments gives information regarding the coordination between the two segments to perform the defined movement. This study aims to see if segment coordination analysis can add more clinical information in comparison to only joint angulation assessment in foot and ankle research.
Method: Gait data were collected from 17 controls, 10 total ankle replacement (TAR) and 10 ankle arthrodesis (AA) patients using 3 D inertial sensors (Physilog®). The participants walked along a 50 m long corridor twice and the movement along each segment was calculated over 100% of gait cycle. The foot was divided into 3 segments: forefoot (ff), hindfoot (hf) and shank (sh). Sagittal angles and angular velocities of each segment were measured and their phase angles (ϕ) calculated. Continuous relative phase (CRP) were also obtained; ϕ ff-hf, ϕ hf-sh and ϕ ff-sh. The CRP outcome of each group was divided into 7 phases and positive (max) peak and negative (min) peak were calculated for each phase and compared ($p < 0.05$).
Results: A max peak indicates that the distal segment is rotating faster than the proximal segment and min peak indicates vice versa. ð Controls: ff-hf and ff-sh segments showed two max peaks during stance and a min peak at initial swing (IS). While at hf-sh a min and max peak at stance and a min peak at IS was reported. ð TAR: The patterns for all three segments were similar to controls, but at hf-sh, during IS, max peak was reported. All the peaks were significantly smaller. ð AA: The pattern was modified with ff performing majority of rotation in ff-hf and ff-sh. While in hf-sh the max peaks at stance and at IS the min peak, same as TAR, was reported, both peaks were significantly smaller.
Conclusion: Based on our results inter-segment coordination adds information which is masked by the existing kinematic assessment method. Combination of the two methods would be useful in understanding the role of individual segment in attaining the defined joint rotation in ankle.

FM 48

Tibiotalocalcaneal vs tibiotalar fusion: a biomechanical comparison

Swati Chopra, Centre Hospitalier Universitaire Vaudois and University of Lausanne, geneva/CH; Dr Rayan Baalbaki, Centre Hospitalier Universitaire Vaudois (CHUV)/CH; Maria Josina Pichonnaz, Centre Hospitalier Universitaire Vaudois (CHUV)/CH; Dr Julien Favre, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne/CH; PD Dr Xavier Crevoisier, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne/CH

Introduction: Tibiotalar fusion/ ankle arthrodesis (AA) is an established surgical procedure for end stage ankle arthrosis. Tibiotalocalcaneal fusion (TTC) is used in combined arthrosis of the ankle and subtalar joints and is also a salvage procedure for diverse ankle-hindfoot pathologies. Biomechanical studies have already shown several drawbacks of AA due to altered gait mechanics. Furthermore, increased compensatory motion of the neighboring joints has been demonstrated in case of AA. Therefore, fusing not only the tibiotalar but also the subtalar joint would result in even greater biomechanical alteration. The study aims to investigate whether or not the fusion of the tibiotalar along with the subtalar joint is biomechanically detrimental.
Method: 42 participants, including controls and 2–5 years TTC (using retrograde intramedullary nail) and AA patients were assessed using foot-worn inertial sensors (Physilog®) and pressure insoles (PEDAR®) along with subjective questionnaires; EQ 5D, AOFAS-hindfoot and FAAM. Each subject performed 2 walking trials of 50 m, per foot. Gait parameters assessed include: Plantar pressure parameters (PPP), kinematics and spatiotemporal parameters. Statistical analysis included the two Wilcoxon tests ($p < 0.05$).
Results: Subjective scores showed no significant difference between the outcomes of both surgeries. Comparing gait results, between the operated (op) sides of TTC and AA- differences in few PPP and in kinematics at MPJ1, midtarsal and ankle joints in the sagittal plane ($p < 0.05$) was reported. Between op vs unop side of TTC – differences were reported in the gait parameters ($p < 0.05$), however, compared to AA, TTC patients showed a good bilateral symmetry. In comparison to controls, both op and unop sides in TTC group showed significant difference in similar gait parameters.
Conclusion: Both operated sides showed similar alteration of gait parameters compared to controls. However, unlike AA group, TTC group showed symmetrical gait pattern, with the unop side loading as much as the op side. Thus, this study concludes that the fusion of the calcaneus along with the tibiotalar joint is less detrimental in terms of hindfoot loading and gait symmetry than fusion of the ankle joint alone.

FM 49

Characterization of gait in female patients with moderate to severe hallux valgus deformity

Swati Chopra, Centre Hospitalier Universitaire Vaudois and University of Lausanne, geneva/CH; Dr Kevin Moerenhout, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne/CH; PD Dr Xavier Crevoisier, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne/CH

Introduction: Hallux valgus (HV) is a common forefoot problem seen in clinical practice. Studies have looked at gait alterations due to HV deformity, assessing temporal, kinematic or plantar pressure parameters individually. Based on a systemic review (Nix S E, et al. 2013) fundamental limitations exist in these studies. Hence, the study aims to assess all gait parameters together and determine clinically relevant gait parameters for HV to assist in post-operative patient prognosis and rehabilitation.
Method: 23 feet in healthy controls, with no sign of HV, and 26 feet in patients with moderate to severe HV deformity, were assessed. The case group presented a mean M1/M2 angle of 14–20°, M1/P1 angle of 20–40° with markedly reduced functional scores, including FAAM of 68.69% (18.5) and AOFAS forefoot of 46.4. Participants performed two walking trials of 50 m each at their natural walking pace, wearing pressure insoles (PEDAR®) and inertial sensors (Physilog®). Comparison between the two groups was made using the Wilcoxon rank sum test, $p < 0.05$. Forward stepwise regression was performed to develop a model with most clinically relevant gait parameters. Parameters assessed: Spatiotemporal: Stance phase, cadence, double support time, limp, stride length, speed, inner stance events (Load, Foot-flat, push-off (%)), toe off pitch angle (TOP), peak swing speed (PSS) Kinematic: Movement around all three planes at MTP1, and total foot. Plantar pressure parameters: Total contact duration, maximum pressure and maximum vertical force in 10 sub-regions of foot.
Results: The results showed clear deterioration in several gait parameters in the HV group compared to controls. Nine gait parameters were isolated to be the most clinically relevant, with a coefficient of determination (r^2) of 71. These parameters include cadence, speed, foot-flat duration, push-off duration, PSS, TOP, MTP1 motion in the sagittal plane, total contact duration at hind foot and peak vertical force at the first toe. These parameters showed good correlation with AOFAS and FAAM scores.
Conclusion: The study successfully isolated nine gait parameters which can best describe the altered gait in HV patients. The clinical significance of this study is the potential benchmarking in characterizing the severity of HV, the simplification of gait assessment for use in clinical practice and potential contribution to objective evaluation of treatment efficacy and value of rehabilitation programs.

FM 50

The role of plantar fascia tightness in hallux limitus functionalis. A biomechanical analysis

Dr. Arnd Viehöfer, Universitätsklinik Balgrist, Zürich/CH; PD Dr. med. Norman Espinosa, Pfäffikon/CH; Dr. Roland Camenzind, Bürgerspital Solothurn, Solothurn/CH; Dr. Artur Kröll/CH

Introduction: Restriction of greater toe dorsiflexion without degeneration of the first metatarsophalangeal joint has been defined as hallux limitus functionalis (HLF). It is believed that in HLF this limitation of greater-toe dorsiflexion takes place in the stance phase (tibia rolls over talus) due to massive tightening of the calf and plantar structures. The current study investigates the role of a tight plantar fascial structure in impaired dorsiflexion of the greater toe.
Methods: For the purpose of the the study 5 (2 right, 3 left) lower limbs from Thiel fixated human cadavers were used. Each specimen was amputated through the middle of the leg and prepared at the Institute of Anatomy of the University of Zurich. To simulate double-limb standing stance the tibia and fibula were mounted on a universal material testing machine (Zwick) and constantly loaded with 350N. The Achilles-, peroneus longus (PL)-, peroneus brevis (PB), flexor digitorum longus (FDL), flexor hallucis longus (FHL), posterior (PTT) tibial- and anterior tibial (ATT)- tendons were all loaded using a custom-made system (AT – 200 N; PTT – 40 N; FDL – 22 N; FHL – 22 N; PB and PL – 35 N; ATT – 40 N). A force of 30N was applied to the extensor hallucis longus (EHL) and extensor digitorum longus (EDL) to simulate maximal extension of the toe. The plantar fascia was fixed to a clamp and tensioned using a threaded bar. Four different loads were applied (approximately 100N, 200N, 300N and 350N). The applied tension was measured using a piezo-electric force transducer, while a digital camera, oriented perpendicular to the foot and centered over the first metatarsal head has been used to measure the amount of extension.

Results: The results show a high correlation (r = 0.9) between the decrease in extension of the hallux and the tension applied to the plantar fascia reaching a maximum decrease of 4.2 (± 0.66) ° (117% compared to the untightened situation) for an applied tension of 350N.
Conclusion: Thightness of the plantar fascia restricts dorsiflexion at the first metatarso-phalangeal joint and results in HLF. Based on these data the authors continue to extend their research in identifying the potential initiative causes of hallux rigidus.

FM 51

The modified Kramer osteotomy for hallux valgus correction – a long-term outcome study

Dr. Christoph Knoth, Kantonsspital Frauenfeld, Zürich/CH; Dr. Leonie Carow, Kantonsspital Frauenfeld/CH; Dr. Rolf Gampp, Kantonsspital Frauenfeld/CH; PD Dr. Ralph Zettl, Kantonsspital Frauenfeld, Frauenfeld/CH; Dr. Florian Hess, Kantonsspital Frauenfeld, Frauenfeld/CH

Introduction: The modified Kramer osteotomy addresses light to severe hallux valgus deformities by reducing the intermetatarsal and metatarsophalangeal angle through a subcapital medial closing wedge osteotomy with lateralization of the first metatarsal head. Stable fixation is achieved by a dynamic angular stable osteosynthesis implant (Link® Hallux Fixator, Germany). The purpose of this study was to describe this new technique for hallux valgus correction and its long-term results.
Material and Methods: From 2006 to 2011, 59 patients (75 hallux valgus) at a mean age of 56 years (min 21, max 80) were operated by the same foot surgeon and were assessed clinically and radiologically after 5 and 12 weeks. 41 patients (55 corrected hallux valgus) could be included in a mean follow-up of 5.6 years after primary surgery (min 3, max 9). 15 patients were lost to follow up and 3 patients died. The clinical outcome was assessed by the foot function index (FFI) and the American Orthopaedic Foot and Ankle Society Forefoot Score (AOFAS) at final follow-up.
Results: The mean AOFAS score was 87/100 (min 30, max 100) and FFI was 6 % (min 0%, max 53%) which demonstrate a high satisfaction at long term follow up. The mean preoperative metatarsophalangeal and intermetatarsal angle was 27.9° (min 14, max 46) and 12.4° (min 6, max 11) respectively. The achieved metatarsophalangeal and intermetatarsal angle in the first follow-up were 12.5° (min 2, max 26) and 5.1° (min 0, max 12) respectively. There was no significant loss of correction of both angles at the final follow-up (p >0.1). There was no case with overcorrection (hallux varus) and wound infection. Implant removal was done in 28 cases. Two cases of non-union were revised and 2 revisions had to be performed because of recurrent deformity.
Conclusion: We propose the modified Kramer osteotomy as a valuable surgical procedure to correct hallux valgus deformity with high patient's satisfaction. Normal angular configuration and good clinical long-term outcome may be achieved even in patients with severe deformity.

FM 52

Outcome after protected weightbearing treatment in diabetic neuropathic osteoarthropathy (Charcot) – A comparison of 101 feet in unilaterally vs bilaterally affected patients

Dr. Niklas Renner, Universitätsklinik Balgrist, Zürich/CH; Dr. Martin Berli/CH; Dr. Thomas Böni/CH

Background: To date, there is still a lack of systematic long-term follow-up reviews in the literature to measure clinical effectiveness in conservative treatment in patients with CN. The aim of the present study was to evaluate and to compare the outcome of unilaterally versus bilaterally affected patients after protected weightbearing treatment of CN in a Total Contact Cast (TCC), and to find possible recommendations for therapy.
Patients and methods: 90 patients (mean age 60 ± 10 years at first diagnosis of CN) with 101 affected feet were enrolled. Retrospective analyses of patient records and radiographs over a period of eleven years (2002–2012) were conducted. Results were compared be-tween patients with unilateral CN (n = 79) versus bilaterally affected individuals (n = 11). Off loading, i.e. protected weightbearing treatment was achieved by a TCC or by using a custom-made orthosis. During follow up, the incidence of ulcer, infection, recurrence and amputation was observed. Mean follow-up was 45 months.
Results: In all patients (n = 90) diabetes was the reason for sensory neuropathy and occur-rence of CN. In accordance with the Eichenholtz classification, 9 feet were diagnosed in the prodromal period, 61 in stage 1 (development), 21 in stage 2 (coalescence) and 10 in stage 3 (reconstruction). Patients with unilateral CN had a shorter off-loading period (20 ± 21 weeks) than bilaterally affected patients (22 ± 29 weeks). Unilaterally affected patients with protected weightbearing treatment had a lower stage of CN at the time of diagnosis than unprotected patients. The probability of the appearance of an ulcer by unilaterally affected patients during treatment was lower for protected weightbearing than for non-protected, full weightbearing patients (8% versus 31%). In 41% of all patients with bilat-eral CN, new ulcers were seen during treatment. There was a significantly higher appear-ance of ulceration between bilaterally compared to unilaterally affected patients with an off-loading regimen (p = 0.004). Soft-tissue infection rate was higher for unprotected weightbearing patients (7%) than for protected weightbearing treatment (2%). No difference was found in recurrence and amputation rate by the different treatment modalities.
Conclusions: Protected weightbearing in a TCC is a safe treatment method in acute CN of the foot and ankle, it reduces the formation of ulceration and infection.

FM 53

Treatment of Charcot arthropathy and osteomyelitis of the same foot

Charlotte Baltin, Zollikon/CH; Dr. Sabra Leupi/CH; Dr. Lazaros Vlachopoulos/CH; Dr. Thomas Böni/CH; Dr. Martin Berli/CH

Background: Charcot arthropathy is a devastating condition with progressive degeneration and joint destruction as a result of any condition resulting in decreased peripheral sensation. In combination with concomitant osteomyelitis the risk of lower extremity amputation increases. The aim of this study was to determine the initial surgical treatment option of the osteomyelitis in presence of a Charcot arthropathy which is associated (1) with a lower amputation rate, (2) fewer high level amputations (3), a shorter duration of antibiotic therapy and (4) a shorter duration of immobilization.
Methods: A retrospective analysis of 40 patients (43 feet) with diagnosis of combined Charcot neuroosteoarthropathy and osteomyelitis of the same foot was performed. As every patient could have a successful treatment for osteomyelitis we identified 60 cases of osteomyelitis for the 40 treated patients. The cases were divided in two groups according to the localization of osteomyelitis in relation to the Charcot affected region – group 1: osteomyelitis outside the active Charcot region and group 2: osteomyelitis within the active Charcot region.
Results: Male patients – mean age, 58.2 years; range, 40.1 to 77.5 – were younger than female – mean age, 70.4 years, range 51.4 to 87.5, p = 0.020. An amputation was performed in 52% of the 60 cases (26 of the 40 patients and 26 of the 43 feet) – in 63% of the 30 cases in group 1 and in 40% of the 30 cases in group 2 (p = 0.091). The amputation level (p = 0.009), the duration of antibiotic treatment (p = 0.045) and duration of immobilization (p = 0.010) differed significantly between the two groups. In the first group, one transfemoral, two transtibial and sixteen forefoot amputations were performed. In the second group, six transtibial, one Chopart-, one Lisfranc- and four forefoot amputations were performed.
Conclusions: Localization of osteomyelitis relative to the active region of Charcot is a relevant factor for prediction of amputation level, duration of antibiotic therapy and duration of immobilization. Therefore osteomyelitis outside and within the Charcot should be considered as different entities. If an osteomyelitis occurs outside the active Charcot primary amputation is probably superior to an internal resection.

FM 54

The Taylor Spatial Frame used as a compression device for hindfoot re-arthrodesis

Dr. Hannes Manner, Schulthess Klinik, Zürich/CH; Dr. Rafael Velasco, Schulthess Klinik, Zürich/CH; Dr. Thomas Rutishauser, Schulthess Klinik/CH; Pascal Rippstein, Schulthess Klinik, Zürich/CH

Introduction: One of the most challenging situations in foot reconstructive surgery is a chronic periprosthetic infection after total ankle arthroplasty or multiple failure of internal fixation for ankle arthrodesis. In this retrospective study we reviewed the clinical and radiological records of 22 patients who were treated with the Taylor Spatial Frame fixator (TSF) in a compression mode in these conditions between 2008 and 2014.
Methods: The clinical and radiological records of 22 patients with failed ankle arthroplasty or repeated failure of internal fixation for ankle arthrodesis were retrospectively evaluated. All patients were treated with an analogical approach which included simultaneous surgical debridement with or without bonegrafting and external stabilization

with the TSF. The charts were reviewed for anamnesis, the surgical procedures in detail, postoperative course and complications.
Results: Ankle arthrodesis with the TSF was performed in 8 women and 14 men. The average age at the time of surgery was 61 years (range, 42–87 years). An average of 2.5 (range: 1–4) previous surgeries had been performed before application of the TSF. The construct of the TSF was similar in all cases with the use of a U-plate for foot fixation and a full ring for tibial fixation. HA-coated pins were used in all cases and additional titanium k-wires for hindfoot and midfoot fixation. Compression to the arthrodesis was applied by shortening of the TSF-struts intraoperatively and 6 weeks postoperatively . As a result, stable ankle arthrodesis could be achieved in 19 out of 22 patients after 14 weeks in the frame followed by treatment in weight bearing cast. Complications were graduated according to Paley. No patient needed to be re-operated during the fixator phase. Two patients in whom failure of fusion occurred returned to ambulation with the help of an orthoprosthetic device. In the other patient, below knee ampuation was indicated.
Conclusion: The fusion rate and low complication rates in this study are promising considering the fact, that all procedures were salvage procedures in poorest bone quality in the elderly patient with multiple previous operations of the ankle joint. The Taylor Spatial Frame, when used in a 3D compression mode, is a versatile external fixator that offers another tool, which the orthopaedic surgeon should consider when treating these difficult cases.

FM 55

Acute fixation of distal fibula avulsion fractures after ankle sprains

Dr. Jasmin Diallo, Kantonsspital Baselland, Liestal/CH; Dr. Joe Wagener, Kantonsspital Baselland/CH; Christine Schweizer, Kantonsspital Baselland/CH; Prof. Dr. Beat Hintermann, Kantonsspital Baselland, Liestal/CH; Dr. Lukas Zwicky, Kantonsspital Baselland, Liestal/CH; Tamara Horn Lang, Kantonsspital Baselland/CH

Introduction: Acute avulsion fractures of the fibula involving the anterior fibulotalar ligament (ATFL) and the fibulocalcanear ligament (FCL) may lead to an elongation of the lateral ligaments due to the dehiscence of the avulsed fragment and the fibula. The resulting mechanical instability facilitates the reoccurrence of ankle sprains. We observed that approximately 40% of our patients who were treated for symptomatic chronic lateral ankle instability simultaneously presented an avulsion fracture. Therefore our treatment strategy was adapted and we performed open reconstruction of the lateral ligaments with fixation of the fragment. Here, we report on our first 10 cases treated with this method.
Method: 10 patients (female, 5; male, 5; age 34 [15–64]) with an acute avulsion fractures of the fibula involving the ATFL and FCL between 2010 and 2013 were treated with an open reconstruction of the lateral ligaments and fixation of the avulsed fragment. Postoperatively the ankle was protected in a walking boot with weight bearing as tolerated. Three months after the surgical treatment moderate sport activities were allowed. Clinical and radiological follow-up controls were conducted at 6 weeks, 3 months and one year postoperative. The clinical stability of the affected ankle was tested using the "Anterior Drawer Test" and compared to the contralateral side by an independent investigator. The reuptake of sports activities as well as patient satisfaction (modified Coughlin-Score) was documented.
Results: No intraoperative or postoperative complications occurred. At a mean follow up of 2 years [1–4] in all cases the avulsion fragment incorporated without dehiscence. None of the cases had a positive anterior drawer test in comparison to the contralateral side. The mean pain was VAS 1,5 [0–4]. All patients returned to their pre-injury sport activities and reported no subjective instability. 6 patients are very satisfied, 4 patients are satisfied with the result.
Conclusion: These promising results encourage us to further treat patients presenting acute avulsion fractures involving the ATFL and FCL using open reconstruction of the lateral ligaments with fixation of the osseous avulsion fragment.

FM 56

First results after mini-open technique in operative treatment of displaced calcaneal fractures

Dr. Matthias König, UniversitätsSpital Zürich, Zürich/CH; Dr. Christian von der Lippe, UniversitätsSpital Zürich/CH; Prof. Dr. Hans-Peter Simmen, UniversitätsSpital Zürich, Zürich/CH; Prof. Dr. Guido Wanner, Universitätsspital Zürich/CH

Objective: Open reduction and internal fixation by an L-shaped Seattle approach has developed to a gold standard in the treatment of displace calcaneal fractures. But wound complications are common and often causing a longer time of hospitalization. Thus, there is a need for a mini-open technique. We report of our first results after osteosynthesis of calcaneal fractures with a special wave-shaped plate using a small subtalar approach.
Methods: The incision is a small 5–8 cm incision over the subtalar joint. This provides direct visualization of the posterior facet and anterior process. A smaller secondary incision can be made posteriorly for screw insertion on the posterior leg of the plate. Reduction is achieved with percutaneous manipulation using a Schanz pin in the posterior tubercle of the calcaneus and guide wires for stabilization and subsequent fixation of the plate. If necessary, off-plate additional cannulated lag screws can be placed to stabilize an anatomically reduced joint surface. To fix the plate locking and non-locking screws can be used depending on the bone quality.
Results: We treated a number of 20 patients with the above mentioned technique in a period of 24 months. Excluding criteria have been comminuted fractures of the posterior tubercle of the calcaneus and non reconstructable fracture patterns, where a primary arthrodesis was performed. The subtalar approach gave o good overview over the posterior facet and also the anterior process, so that even Type Sanders IV fractures could be reduced satisfactorily. Valgus/Varus deformity could be well addressed by reduction with the Schanz pin. Operation time decreased by experience of the surgeons and showed no significant difference in comparison to the open procedure. We didn't see any wound complications.
Conclusion: The Mini-open technique in the treatment of calcaneal fractures is an alternative technique to protect the surrounding tissues and minimize soft tissue exposure. The clinical results illustrate that this technique is able to achieve good results even in complex fracture patterns.

FM 57

Temporary arthrodesis for ligamentous and osseous Lisfranc injuries: outcome and technical tip

PD Dr. Fabian G. Krause, Inselspital Bern, Bern/CH; Dr. Felix Paradies, Inselspital Bern, Bern/CH; Dr. Mohammadreza Abbasian, Inselspital Bern, Bern/CH; PD Dr. Martin Weber, Zieglerspital Bern, Bern/CH

Background: Open rather than closed reduction and temporary arthrodesis as well as primary definitive arthrodesis are well accepted for ligamentous and osseous Lisfranc injuries. For ligamentous injuries better outcome after primary definitive partial arthrodesis has been published.
Methods: Out of 135 Lisfranc injuries that were treated from 1998 to 2012 with open reduction, temporary arthrodesis, and restricted weightbearing in a lower leg cast for three months, 29 ligamentous Lisfranc injuries were available for followup. They were compared to 29 osseous Lisfranc injuries matched in age and gender. Satisfaction, function, and pain were assessed by the AOFAS midfoot score, FFI, SF 36, and VAS for pain. Loss of reduction and midfoot arthritis were evaluated by weightbearing radiographs.
Results: Between the groups with ligamentous and osseous Lisfranc injuries, there were no significant differences in average age (39.9 versus 38 years) or in average followup time (8.3 versus 9.1 years). Also, significant differences were neither seen in the AOFAS midfoot score (84 versus 85.3 points), the FFI pain scale (9.9. versus 14.9 points), SF 36 physical component (56.2 versus 53.9 points), SF 36 mental component (57 versus 56.4 points), nor in the VAS for pain (1.6 versus 1.5 points). The FFI function scale was significantly lower in the ligamentous group (11.6 versus 19.5 points). Radiographically, loss of reduction was recorded three times in the ligamentous injuries and four times in the osseous injuries. Arthritis on the radiographs was mild/moderate/severe in 5/3/0 ligamentous injuries and in 7/2/1 osseous injuries, requiring one definitive secondary Lisfranc arthrodesis in either group.
Conclusion: Open reduction and temporary arthrodesis in ligamentous and osseous Lisfranc injuries led to equal appropriate medium-term outcome. Inferior outcome in ligamentous injuries were not confirmed.

FM 58

Treatment of severe foot deformity with the Taylor Spatial Frame

Dr. Hannes Manner, Schulthess Klinik, Zürich/CH; Dr. Rafael Velasco, Schulthess Klinik, Zürich/CH

Introduction: Severe foot deformity is mostly treated with acute correction and arthrodesis. This may lead to a short and stiff foot with the advantage of a relatively short time of immobilization. There is a large number of reports on gradual deformity treatment with the Ilizarov Ringfixator but only few on the treatment with the Taylor Spatial Frame.
Methods: Between 2005 and 2009 we performed 8 gradual deformity corrections with the Taylor Spatial Frame in 7 patients. The average age was 13 years. The etiology was recurrent clubfoot deformity and neurological foot deformity in 4 cases each. We used a bilevel frame construct in 5 cases for correction of hindfoot as well as midfoot deformity and a simple frame construct for midfoot correction in 3 cases (total number of frames: 13). Bony deformity correction was performed in 10 cases and soft tissue correction in 3 cases. Follow up ranges from 6 to 10 years.
Results: We achieved very promising functional and cosmetic results in all patients. Besides complete correction of all underlying deformities, the feet could be lengthened at the site of the osteotomy to achieve equal foot length. Duration of treatment in the frame averaged 4 months with subsequent casting. There were no major complications. All bony corrections healed well. In the long term there was no recurrence of the deformity except for one case with mild recurrent equinus after soft tissue correction only.
Conclusion: We believe that the use of the Taylor Spatial Frame allows for very accurate correction of even severe soft tissue and bone deformity in the foot. The possibility of multidimensional and simultaneous correction with one single frame construct (hexapod system) enhances the accuracy of the correction and has several advantages compared to the Ilizarov Frame. The surgeon should have advanced experienced with the Taylor Spatial Frame and should consider some special fixation methods.

FM 59

Elbow dislocation in children. A retrospective study

Maria Stoichita/DE; Martina Rothenbühler/DE; Dr Aline Bregou Bourgeois, CHUV, Forel/CH; Dr. Stephane Tercier/DE; Prof. Dr Pierre-Yves Zambelli, CHUV, Lausanne/CH; Dr Nicolas Lutz, Lausanne/CH

Introduction: Traumatic elbow dislocations in children are rare but first among all pediatric joint dislocations. The relationship between problems encountered during reduction, type of dislocation and long-term outcome is not yet clearly outlined in the literature. The aims of this study were to identify possible factors for poor outcome in children who suffered an elbow dislocation.
Method: Retrospective review of all children below 16 years of age, admitted between 2000 and 2013 to the CHUV with a history of elbow dislocation. Monteggia lesions and recurrent dislocations were excluded. Demographic data were recorded. Difficulty in reduction, treatment modalities, duration of immobilization and complications were noted. Variables were compared using the Mann-Whitney test and statistical analysis of ROM limitation was performed.
Results: 83 children had elbow dislocations. Two recurrent and 8 Monteggia lesions were excluded. Among the remaining 73 children were 30 girls and 43 boys, including one boy with bilateral non-simultaneous dislocation. The median age was 10 years (range: 5–15). An associated fracture was diagnosed in 46 patients. Reduction was difficult in 7. Surgery was performed in 29. Follow-up revealed 24 children with a significant final ROM limitation. Each additional year increased the ROM limitation (coef. 1.08: 1.03–1.14, p = 0.003). A fracture was associated with a decrease ROM limitation (coef. 0.7: 0.53–0.93, p = 0.014). A difficult reduction was associated with a decreased ROM limitation (coef. 0.55: 0.39–0.8, p = 0.001). The measured ROM limitation 2 months following removal of the cast (n = 31) was a median 38.3°. Complications occurred in 16 patients.
Conclusions: Reduction was difficult only in cases of pediatric elbow dislocation with an associated fracture. Two months of mobilization are necessary to observe a median ROM limitation of 38.2°(IQR: 7 – 70°). An associated fracture and a complication were not associated with a poorer final ROM.

FM 60

Fixing by two or three parallel pins bridged in supracondylar fractures in children

Prof. Dr Pierre-Yves Zambelli, CHUV, Lausanne/CH; Norman Siegenthaler, UNIL / CHUV/CH

Context: The displaced supracondylar fractures are classically reduced and stabilized by two or three parallel K-Wire side entry at the lateral side according the Judet technique. The purpose of this study is to demonstrate – on synthetic humerus – if an equivalent mechanical stability with 3 pins can be achieved using a non-invasive bridging device locking 2 pins.
Method: 15 synthetic humerus were sawn to simulate a supracondylar fracture through the center of the olecranon fossa. Samples were fixed on three side entry configurations: 2-pin, 2-pin and 3-pin bridged. A twisting machine was used to test the samples; four mechanical properties were measured: the rigidities in internal and external rotation, the maximum torques in internal and external rotation for an angle of 10°. Statistical analysis by Student's t test was performed.
Results: 2-pin configurations – bridged or not – showed identical mechanical properties. 3 pin configuration shown for each mechanical feature the following gains, respectively, compared to 2-pin and two-pin bridged: internal rotational stiffness increases by 21.2% and 25.3%, external rotation of 15% and 6.8%; the maximum internal rotation torque wins 15.1% and 16.4%, for the external rotation 12.35% and 13.3%. The bridging device has not brought the expected mechanical advantage, which would prevent the installation of a third pin. This study however identified a third spindle provides increased stability for the four measured mechanical properties; this gain is desired, when two pins are not enough to stabilize a closed reduction. Statistically, only a comparison of stiffness in external rotation between 2 pin and 3-pin was significant (P <0.05). No statistical difference could differentiate the 2-pin configurations.
Conclusion: The idea to lock 2 pins by a non-invasive device and achieve equivalent stability 3 pins for a supracondylar fracture would eliminate the use of a pin, thus reducing invasive procedures and iatrogenic risks. Nevertheless for instable fracture type 4 or in flexion, the 3 pins solution remains the most stable.
Keywords: Biomechanical analysis supracondylar fracture, humerus, plug, pin bridging.

FM 61

Metamorphosis of normal human lumbar vertebrae to quadruped-like shape by VEPTR induced growth modulation

Prof. Dr. Carol Hasler, Universitätskinderspital beider Basel, Basel/CH; Dr. Daniel Studer, Universitätskinderspital beider Basel, Basel/CH; Dr. Philippe Büchler, University of Bern, Medical Faculty, Bern/CH

Study Design: Retrospective radiographic Objective: To assess the growth modulating impact of yearlong distraction-based VEPTR-treatment on vertebral morphology.
Methods: We digitally measured lumbar vertebral body heights (VBH) and upper endplate depths (VBD) at the time of the index procedure and at follow-up in 9 patients with rib-to-ileum constructs (group 1) spanning a normal lumbar spine. Nine patients with congenital thoracic scoliosis and rib-to-rib constructs but uninstrumented lumbar spines served as controls (group 2). All had undergone more than 8 halfyearly VEPTR expansions. Wilcoxon signed-rank test was used for statistical analysis of initial VBH, VBD, height/depth ratio and at follow-up (significance level 0.05).
Results: The average age was 7.1 years (G1) and 5.2 year (G2, p >0.05)) at initial surgery, the average overall follow-up time 5.5 years (p >0.05). In both groups VBH increased significantly without significant intergroup difference. Group 1 did not show significant growth in depth, whereas VBD increased significantly in the control group. As a consequence H/D ratio increased significantly in group 1 whereas it remained unchanged in group 2. The growth rate in mm/year was 1.4 (group 1) and 1.1 (group 2, p = 0.45) for height and –0.3 and 1.1 (p <0.05) for depth, respectively.
Conclusion: VEPTR growth modulating treatment alters the geometry of vertebral bodies by increasing the height/depth ratio. We hypothesize that in parallel to the distraction-induced gain of vertebral height, the implant related deprivation from axial loads (stress-shielding) impairs anteroposterior growth. The biomechanical consequence of such slender vertebrae exposed to unprotected loads in case of definitive VEPTR removal at the end of growth is uncertain.

FM 62

VEPTR (vertical expandable prosthetic titantium ribs) promotes spinal growth in instrumented segments – a 3D radiographic analysis

Prof. Dr. Carol Hasler, Universitätskinderspital beider Basel, Basel/CH; Amélie Burckhardt/CH; Dr. Philippe Büchler, University of Bern, Medical Faculty, Bern/CH

Introduction: The growth promoting effect of repeat expansions of VEPTR implants in children with early onset scoliosis has so far only been examined by simple measurement of the global T1-S1 distance and by a single CT study investigating the elongation of osseous spinal bars in patients with congenital deformities. The latter was performed at the institute of the VEPTR inventor. We therefore tested the hypothesis that VEPTR promotes spinal growth.
Method: A new software was developed which allows to compute the length of the spine in space based on a digitized measurements on an ap and lateral standard radiograph. Since magnification factors are not consistent and the computation of absolute lengths may lead to errors, we compared the relation R (I/NI) between the lengths of the instrumented (I) and non instrumented (NI) parts of the spine. Untreated, the sick segments of the spine would grow less than the normal vertebrae. We therefore hypothetized that VEPTR promotes growth if the relation R would not change significantly over time. We included 26 early onset scoliosis patients (14 congenital, 10 neuromuscular, 1 idiopathic, 1 secondary) treated at our institution with an observation period of 4 years. The relative lengths after the index procedure R1 and after 4 years R2 were statistically evaluated by paired-sample-t-tests (SPSS Vers.12, significance level $p < 0.05$) by an independent statistician.
Results: Repetitive measurements of the same radiographs at different time points showed a high reliability (coefficient of variation of <0.03%) There was no significant change in the relation of lengths between the instrumented and non instrumented parts of the spine over time.
Conclusions: A new software and methodology provides reliable assessment of the growth stimulating effects of spinal implants in children with early onset deformities. VEPTR instrumentation and repeat halfyearly expansions of the telescopic mechanism promotes growth of the affected, instrumented spine segments. Subsequently the resulting, stimulated growth does not significantly differ from the growth in the normal, unaffected segments as it would naturally without treatment.

FM 63

Phonomyography (PMG) as a continuous noninvasive detection method for Acute Compartment Syndrome (ACS); evaluation using a rat ACS model

Dr Frédéric Vauclair, Centre hospitalier universitaire de Lausanne, Lausanne/CH; Emilie-Ann Downey, McGill University/CH; Adriana Martinez Gomez, McGill University/CA; Thomas Hemmerling, McGill University/CA; Neil Saran, Université de Montréal, Faculté de Médecine/CA; Marilène Paquet, Université de Montréal, Faculté de Médecine/CA; Greg Berry, McGill University/CA

Introduction: Phonomyography (PMG) is a non-invasive acoustic technique by which microphones placed on the skin surface detect the low-frequency sounds emitted by muscle upon contraction. Presently, there is no reliable non-invasive continuous monitoring technique for the detection of acute compartment syndrome (ACS), a traumatic condition seen in military and civilian trauma victims. The phase 1 of this study (ischemia induction of 15 adult rat legs through direct iliac vessel clamping) has already shown promising results with decrease in the signal amplitude of PMG proportional to ischemia duration. The goal of the phase 2 is to confirm the ability of PMG to detect early changes in muscle contraction during ACS in a rat model.
Methods: In 14 adult Sprague Rats, an ACS was induced by infusion of a physiologic saline solution into the left posterior calf compartment (direct ACS induction model), while the right posterior calf compartment was used as a control. At intervals of 10 minutes, for a maximum of 6 hours, the sciatic nerve of each leg was stimulated with a transcutaneous nerve stimulator, and the PMG acoustic signal recorded. A total of 15 rats were included (with variable ACS duration time of 30 min, 1h, 2h, 4h and 6 h with 3 rats in each group). One rat in the 6h group died after 5h and was excluded. We performed fasciotomy at the end of the experiment. At day three, muscles biopsies were harvestered.
Results: The PMG showed a decrease in the amplitude of the low-frequency signal emitted from injured muscle of the ACS limb, which correlated with the duration of muscle and nerve injury/ischemia and histologic necrosis. At time t = 4h, there was a statistically significant ($p < 0.05$) decrease of the phonomyography signal (median decrease 92.7%, $n = 5$; $p = 0.043$) with positive correlation with muscle necrosis in biopsy.
Conclusion: These findings further confirm the results obtained during the phase 1 (ischemia induction through iliac vessel clamping) and the potential of PMG as a continuous non-invasive detection method for ACS, by showing an alteration in the acoustic signal emitted by the muscles of an injured/ischemic limb. ACS induction was proved by muscle histopatological findings. This promising non-invasive technique for ACS detection needs further evaluation in human being. (PMG is a patented device)

FM 64

Proximal Extensor Digitorum Longus Tendon transfer (PEDLT): a modified animal model to study dynamic tendon-bone tunnel healing

Dr. Marco Germann, Universitätsklinik Balgrist, Zürich/CH; Dr. Karl Wieser, Universitätsklinik Balgrist, Zürich/CH; Dr. Christoph Agten, Universitätsklinik Balgrist, Zürich/CH; PD Dr. med. Sandro F. Fucentese, Universitätsklinik Balgrist, Zürich/CH; Dr. Katja Nuss, Vetsuisse Faculty, University of Zurich, Zürich/CH; Prof. Dr. Jess Snedeker, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. med. Christian Gerber, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Dominik Meyer, Universitätsklinik Balgrist, Zürich/CH

Introduction: An animal model to study proximal extensor digitorum longus (EDL) tendon graft healing in a bone tunnel under the rabbit's tibial plateau was described by Yamakado in 2002. It was the aim of this study to modify the animal model so that dynamic healing of the tendon in the bone could be studied without restricting range of motion.
Methods: The EDL was released from its origin at the lateral femoral condyle in 18 left knees of white New Zealand rabbits. The EDL was mobilized until its central tendon was clearly identified. The central tendon was cut approximately 20 mm below the joint line. The connecting muscle was left intact, thereby reducing the maximal muscle action. The position of the tendon with respect to the tibial plateau was measured, before and after release with the tendon under a pull of 20N applied with a spring balance. A bone tunnel was drilled parallel to the tibial plateau from the extensor sulcus to the medial border of the tibia. The EDL tendon was then folded and inserted into the bone tunnel with a 2-0 fibre wire suture which was then attached to a 5 mm PEEK cortical button. In nine rabbits the folded tendon was pressed and coated with tricalcium phosphate granules before implantation. Postoperatively, the rabbits were returned to free cage activity. 84 days postoperatively all animals were sacrificed, the left knee was dissected and micro CT scan was performed for all animals. MRI was performed for 12 animals.
Results: Micro CT scan showed that the bone tunnel was in the cancellous epiphysis in 7, in the medullary cavitiy in 5 and in both parts of the bone in 5 animals. In 1 animal the bone tunnel was consolidated showing that the tendon graft was pulled out early after surgery. Cutting of the central tendon led to a mean lengthening of 6mm in the fully dorsiflected ankle joint, with a clear continuity of the proximal tendon stump and the distal muscle. MRI showed fatty infiltration (grade 1) in 1 case and no fatty infiltration in 11 cases.
Conclusion: PEDLT is a surgically well controllable procedure to study tendon to bone healing in an animal model in which the tendon graft is dynamically loaded by the animal. The main surgical difficulty is the precise placement of the bone tunnel. The model allows to study and compare healing of various tendon graft preparations to bone under dynamic loading conditions.

FM 65

Joint instability induces an inflammatory response in a rabbit knee model

Dr. Christian Egloff, University Hospital Basel, Basel/CH; David A. Hart, University of Calgary, Calgary/CH; Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; Prof. Dr. Dr. med. Victor Valderrabano, Universitätsspital Basel, Basel/CH; Prof. Walter Herzog, University of Calgary/CA

Introduction: Joint instability is considered to promote early osteoarthritic changes in the knee. Also inflammatory reactions are associated with cartilage degradation in osteoarthritis. Therefore, the goal of the present study was to investigate the in vivo effects of joint instability on the expression of proinflammatory proteinases implicated in OA in an otherwise intact rabbit knee joint model.
Methods: 10 1-year-old female New Zealand White rabbits (average 5.7 kg, range 4.8–6.6 kg) were randomly assigned to receive unilateral

intramuscular injection of Botulinum toxin A (BTX-A, n = 5) termed "instability group" or no treatment (n = 5), termed control group. This resulted in three groups for analysis: normal knees from the control group, experimentally treated knees from the instability group, and contralateral, untreated knees from the instability group. After ninety days, synovial tissue, collateral ligaments and menisci from both compartments of all knees were collected and analyzed for specific mRNA levels using RT-PCR. mRNA levels were compared across groups using multivariate linear regression with adjustment for tissue type and compartment.
Results: The instability group showed significant elevations of biglycan (Coef 6.3; 95% CI 0.2–3.3; p = 0.023), cathepsin K (Coef. 0.6; 95% CI 0.05–0.5; p = 0.019), IL-6 (Coef. 3.1; 95% CI 0.2–6.1; p = 0.039) and MMP-13 (Coef 8.4; 95% CI 0.8–16.5; p = 0.039) mRNA levels in the medial and lateral meniscus. The posthoc analysis showed a significantly higher expression in the medial than the lateral meniscus (p <0.001). The collateral ligaments showed no consistent changes compared to the control animals. The analysis of the synovial tissue showed significant elevation of collagen I (p = 0.002), collagen III (p = 0.022) and INOS (p = 0.013), TGF-B (p = 0.001), IL-1 (p = 0.038) and IL-6 (p = 0.027). Borderline significance showed COX-2 (p = 0.065).
Conclusion: Joint instability in a muscle paralysis model leads to expression of proinflammatory, degradative proteinases of the synovial tissue in the otherwise intact knee joint. This result is surprising and adds to the literature the idea that joint instability caused by muscle paralysis may promote an inflammatory intraarticular milieu, which may contribute to the development of early stages of OA.

FM 66

ROBUST-regeneration of osteoporotic bone using stem cell transplantation

Dr. Franziska Saxer, University Hospital Basel, Basel/CH; PD Dr. Arnaud Scherberich, University Hospital Basel, Basel/CH; Dr. Patrick Studer, Universitätsspital Basel, Basel/CH; Dr. Sylvie Miot, University Hospital Basel, Basel/CH; Dr. Atanas Todorov, University Hospital Basel, Basel/CH; Dr. Sinan Güven, University Hospital Basel, Basel/CH; Dr. Simone Schreiner, University Hospital Basel, Basel/CH; PD Dr. Martin Haug, University Hospital Basel, Basel/CH; Prof. Dr. Dirk Johannes Schaefer, University Hospital Basel, Basel/CH; Prof. Dr. Michael Heberer, University Hospital Basel, Basel/CH; Prof. Dr. Ivan Martin, University Hospital Basel, Basel/CH; Prof. Dr. Marcel Jakob, Universitätsspital Basel, Basel/CH

The heterogeneous human adipose stromal vascular fraction (SVF) possesses osteogenic potential without pre-differentiation [1–3]. This recommends the cell population for one-step grafting procedures and fracture-augmentation especially in osteoporotic patients [4–5], in whom the dysfunctionality of bone marrow derived stem cells renders autologous bone grafting questionable. Safety and feasibility of the approach are assessed in this first-in-men trial. Patients with indication for surgical treatment of low-energy proximal humeral fractures were included if liposuction was feasible. The cell-suspension isolated from the aspirate in an automated device (Celuion 800/CRS, Cytori, USA) was implanted using a hydroxyapatite carrier before osteosynthesis with a PHILOS-plate (Synthes, CH). Follow-up was performed 6, 12 and 24 wks. postoperative including osteodensitometrie. A cell-sample was analysed using clonogenicity-/differentiation-assays and fluorescent activated cell sorting (FACS). In case of later implant removal a biopsy was taken for histology. Eight patients (mean age 69 yrs) were treated without procedural difficulties. Patients reported only minimal pain scores at the liposuction site. Four serious adverse events (hospitalisation of study-patients) were documented, none related to the novel technique. The cell-analysis revealed an average clonogenicity of 10% with osteogenic potential in 30% of clones. FACS showed high rates of mesenchymal progenitors proportional to the total cell-count with a constant population of endothelial progenitors. Histology of 5 biopsies after min. 6 months revealed the presence of bone and functional vascular structures within the graft. This one-step approach using adipose tissue as cell source for bone grafting is safe and feasible. The heterogeneous SVF could support vascularisation additional to bone formation, circumventing the dysfunctionality of autologous bone graft in elderly patients. This proof of principle underlines the prospects of the approach as alternative to standard grafting procedures.

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FM 67

Notochordal Cell Conditioned Medium (NCCM) significantly enhances cartilage matrix production in osteoarthritic human articular chondrocytes

Dr. Sebastian Müller, Universitätsspital Basel, Basel/CH; Prof. Dr. Marcel Jakob, Universitätsspital Basel, Basel/CH; Dr. M. Zia Karim, Toronto Western Research Institute, Toronto, Ontario/CA; PD Dr. Ajay Matta, Toronto Western Research Institute, Toronto, Ontario/CA; Sandra Feliciano, Universität Basel/CH; Lina Acevedo, Universität Basel/CH; Dr. Arne Mehrkens, Universitätsspital Basel, Basel/CH; Prof. Dr. Stefan Schären, Universitätsspital Basel, Basel/CH; Prof. Dr. Ivan Martin, University Hospital Basel, Basel/CH; Prof. Dr. Michael Heberer, University Hospital Basel, Basel/CH; Prof. Dr. William Mark Erwin, Toronto Western Research Institute, Toronto, Ontario/CA; PD Dr. Andrea Barbero, University of Basel/CH

Introduction: It has recently been shown that notochordal cell conditioned medium (NCCM), derived from non-chondrodystrophic canines protects animal and human nucleus pulposus cells from degradation and induced apoptosis. Here, for the first time we assessed whether the post-inflammatory recovery of human articular chondrocytes within an engineered cartilage tissue is enhanced by NCCM and whether NCCM had influence on cartilage matrix production of osteoarthritic chondrocytes.
Methods: Chondrocytes harvested from cartilage samples of 6 non-osteoarthritic patients (healthy, 18–68 years; group I: <55 years, group II: >55 years) and from 7 osteoarthritic donors (mean age 75,6, range: 60–82 years) that underwent total knee replacement were expanded for two passages and then chondro-differentiated in pellets for 3 weeks. Resulting tissues were exposed for 72 hours to IL-1b/TNF-a (inflammation culture) and then cultured up to 14 days in medium containing 2% FBS supplemented NCCM (2% NCCM) or 2% FBS supplemented ADMEM (ctr) (recovery culture). Pellets generated with OA chondrocytes without inflammatory pretreatment were cultured in NCCM- or ctr-medium. Tissues after each culture phase were analyzed biochemically (glycosaminoglycans – GAG/DNA), (immuno-)histologically (collagen II and GAG) and by RT-PCR.
Results: Inflammatory treatment resulted in a significant loss of GAG from the pellets generated by healthy and OA chondrocytes. Response to NCCM was age and disease-dependent: GAG contents (i) of group I cell-pellets was not significantly influenced by NCCM, (ii) of group II cell-pellets recovered to baseline levels only in NCCM medium, (iii) of OA chondrocytes-pellets without inflammatory pretreatment significantly increased in response to NCCM to levels 1.8-fold higher than baseline. (Immuno-)histological results confirm these trends. NCCM did not significantly modulate the expression of inflammatory and anabolic genes.
Conclusions: NCCM enhances cartilage matrix production by IL-1b/TNF-a-treated chondrocytes from healthy patients >55 years and by end stage OA chondrocytes. Research activities are ongoing to investigate the mechanisms whereby NCCM confers such restoration and chondroprotection. Based on these promising first results, successful further in vivo studies may lead to an injectable agent for the early treatment of inflammatory and degenerative joint diseases.

FM 68

Osteosclerotic bone phenotype is stably imprinted in subchondral mesenchymal stromal cells in hip and knee osteoarthritis

Dr. Daniel Bianco, Universitätsspital Basel, Basel/CH; Tomislav Cengić, Universitätsspital Basel, Basel/CH; PD Dr. Geert Pagenstert, Universitätsspital Basel, Basel/CH; Dr. Csaba Forster-Horváth, Universitätsspital Basel, Basel/CH; Prof. Dr. Dr. med. Victor Valderrabano, Universitätsspital Basel, Basel/CH; PD Dr. Thomas Hügle, Universitätsspital Basel, Basel/CH; Dr. Jeroen Geurts, Universitätsspital Basel, Basel/CH

Introduction: Subchondral bone sclerosis in osteoarthritis (OA) is characterized by an increase of bone material that is hypomineralized, caused by a dysregulated osteoblast phenotype. This increased bone anabolism suggests the involvement of mesenchymal stromal cell (MSC) recruitment and their differentiation into osteoblasts. In this study, we investigated whether the properties of these osteoprogenitors have changed in nonsclerotic and sclerotic OA subchondral bone.
Methods: Knee tibial plateaus and femoral heads were obtained from patients undergoing total knee and hip arthroplasty. Subchondral bone tissues from nonsclerotic and sclerotic regions were digested and nucleated bone marrow cells were isolated. Osteogenic (CFU-O) and total number of colonies (CFU-f) were counted after alkaline phosphatase (ALP) and methylene blue staining, respectively.

Confluent cultures were subjected to osteogenic differentiation for three weeks and evaluated using ALP staining, quantitative ALP assays and qualitative analysis of mineralization by Alizarin Red staining.
Results: CFU-f counts were 20.1 ± 2.2% in nonsclerotic and 17.0 ± 3.5% in the sclerotic subchondral tissue, without statistical differences between regions. Osteogenic potential of MSCs from knee joints was very high without significant differences between nonsclerotic (91.8 ± 1.6%) and sclerotic (91.6 ± 3.4%) tissues. Significant statistical differences were also absent for the hip comparing nonsclerotic (69.8 ± 5.6%) and sclerotic (56.0 ± 19.1%) tissues; but their osteogenic potential was significantly reduced ($p < 0.05$) when compared with the knee. Osteogenic differentiation was efficient demonstrating a 5.4- and 4.2-fold increase of ALP activity in nonsclerotic and sclerotic MSCs, respectively. Five out of six donors had significant differences in ALP activity between nonsclerotic and sclerotic MSCs. In vitro mineralization was absent in nonsclerotic MSCs. Sclerotic MSCs demonstrated strong mineralization only in one donor.
Conclusions: Our findings suggest that MSCs derived from OA subchondral tissues adopt an aberrant osteoblastic phenotype upon osteogenic induction. Differential ALP activity and hypomineralization, characteristics of OA subchondral bone sclerosis, appear stably imprinted in tissue-resident osteoprogenitors.

FM 69

Mechanistic determination of notochordal cell-induced anti-apoptotic signaling in human nucleus pulposus cells

Dr. Arne Mehrkens, Universitätsspital Basel, Basel/CH; Dr. M. Zia Karim, Toronto Western Research Institute, Toronto, Ontario/CA; PD Dr. Ajay Matta, Toronto Western Research Institute, Toronto, Ontario/CA; Sarah Kim, Toronto Western Research Institute, Toronto/CA; Prof. Dr. Michael G Fehlings, Toronto Western Research Institute, Toronto/CA; Prof. Dr. Stefan Schären, Universitätsspital Basel, Basel/CH; Prof. Dr. William Mark Erwin, Toronto Western Research Institute, Toronto, Ontario/CA

Introduction: A minimally invasive method through which nucleus pulposus (NP) cell viability and function could be maintained or even enhanced would revolutionize the treatment of degenerative disc disease (DDD). Previously, we demonstrated that notochordal cell conditioned medium (NCCM) (derived from non-chondrodystrophic (NCD) canine IVD NPs) is able to suppress apoptosis of human NP cells in a caspase-dependent fashion in 40% of our donors. Our current work concerns the mechanisms by which notochordal cell-induced anti-apoptotic signaling in human NP cells occurs as well as the characterization of differences in responding vs. non-responding NP-cells to our treatment.
Materials and Methods: We developed NCCM from hypoxic culture of freshly isolated NPs from NCD canines. We obtained human NP cells from 30 patients undergoing spinal surgery. The cells were cultured with ADMEM/F-12 (control media) or NCCM under hypoxic conditions (3.5% O_2) and treated with Etoposide (all supplemented with 2% fetal bovine serum). Changes in extracellular matrix and apoptosis-related genes were determined with array-based gene expression methods, Western blots were performed for probing of expression of apoptotic-related proteins. Further studies included Cytokine ELISA and MTT assays.
Results: Cells treated with NCCM demonstrated an upregulation of XIAP and Rab25 as well as a number of important extracellular matrix molecules including collagens and TGFβ1 and downregulation of a number of matrix metalloproteinases. They also showed increased cell viability at 24h. Responder cells secreted low levels of IL-6 and IL-8 into the culture medium whereas non-responder cells secreted elevated levels of both of these cytokines.
Conclusions: In the presence of Etoposide, soluble factors secreted by the NCD IVD NP induce an increased expression of the inhibitor of apoptosis XIAP plus the pro-survival factor Rab25 and increased ECM protein expression as well as TGFβ1. Differences in cytokine expression of responders vs. non-responders suggest a possible biochemical profile for NP cells that may be suitable for biologic therapy. The components of NCCM remain incompletely identified, however here we identify the mechanisms whereby NCCM suppresses cell death and rescues the expression of ECM genes suggesting that the essential components of factors secreted by notochordal cells could lead to a novel cellular and molecular strategy for the treatment of DDD.

FM 70

Corrective osteotomies of phalangeal and metacarpal malunions using patient-specific guides: CT-based accuracy evaluation

Dr. Stefanie Hirsiger, Uniklinik Balgrist, Zürich/CH; Dr. Junichi Miyake/JP; Dr. Philipp Fürnstahl/CH; Prof. Dr. Ladislav Nagy/CH; PD Dr. Andreas Schweizer, Uniklinik Balgrist, Zürich/CH

Introduction: Corrective osteotomy of metacarpal and phalangeal malunion is indicated if pain or impairment of hand function is present. Surgical planning is traditionally based on conventional radiographs and clinical findings. Based on computed tomography (CT), three-dimensional (3D) deformity analysis and correction using patient-specific guides is well-established for intra- and extra-articular radius malunions. However, the applicability in posttraumatic deformities of the hand skeleton has not yet been investigated. We present 8 3D-planned corrective osteotomies of phalangeal and metacarpal malunions.
Methods: 6 patients (8 osteotomies) treated at the University Hospital Balgrist in Zurich between 12/2011 and 08/2014 were included. Patients underwent clinical and radiological evaluation preoperatively, directly postoperative, and at last follow-up (mean 6 months, range 5–11 months). CT-based 3D models were generated and used for preoperative planning, guide design, and postoperative accuracy evaluation. Deviations were expressed in 6 degrees of freedom by comparing 3D angular and translation differences.
Results: Evaluation of accuracy showed a substantial postoperative decrease of deformity with a mean residual deviation of 2.96° (range 1.1–5.8°) and 0.59 mm (range 0.2–1.3 mm) postoperatively compared to 13.3° (range 9.3–27.4°) and 1.93 mm (range 1.0–3.6 mm) preoperatively. We did not observe secondary dislocation, nonunion, complex regional pain syndrome, or complications necessitating surgical revision other than hardware removal (2 patients). All patients were satisfied with the surgical outcome, range of motion was improved, and all but one patient gained grip strength.
Conclusion: In our experience, preoperative 3D planning combined with patient specific guides is a feasible technique for correcting malunions of metacarpal and phalangeal bones. In the presented cases, accurate correction of deformity and favorable clinical outcomes were achieved. Compared to the conventional technique, drawbacks are higher costs and increased planning effort; advantages are a more detailed deformity analysis in all 6 degrees of freedom, easy intraoperative application, and a highly precise anatomical reconstruction. For these reasons, we currently prefer the above mentioned technique for assessment and treatment of complex multiplanar or intra-articular metacarpal and phalangeal malunions. Level of evidence Retrospective case series, evidence level 4.

FM 71

Collagenase injection in Dupuytren's disease: observations and conclusions in 203 patients

Caroline Krefter, Schulthess Klinik, Zürich/CH; Dr. Miriam Marks, Schulthess Klinik, Zurich/CH; Martina Wehrli, Schulthess Klinik/CH; Stefanie Hensler, Schulthess Klinik, Zurich/CH; Dr. Daniel Herren, Schulthess Klinik, Zürich/CH; Dr. Stephan Schindele, Schulthess Klinik, Zurich/CH

Introduction: Collagenase (Xiapex®) is a new treatment option in treatment of dupuytren's contracture in Switzerland since 2012. Aim of this ‚conservative' treatment is enzymatic digestion of an isolated cord which cause flexion contracture in fingers. After exposure time of about 24 hours or more the cord can be easily disrupted by external manipulation. Since the beginning of this new treatment option at our institution all data have been collected and evaluated in a registry. Combined with personal observations the results and conclusions drawn influencing the actual indications and treatment modalities will be presented.
Methods: Since the first use of collagenase in February 2012 at our institution the data of all patients (n = 203) have been retrospectively recorded, since August 2013 prospectively. Before and 6 weeks after injecting the sum of the extension lag in the MCP, PIP and DIP joints, subjective outcome using the brief Michigan Hand Outcomes Questionnaire (briefMHQ) and complications were assessed.
Results: From 134 patients recorded retrospectively and 69 patients prospectively the summed extension lag over all 3 finger joints decreased from 75° (±33) at baseline to 23° (±29) at follow up ($p \leq 0.001$). In the briefMHQ patients increased from 73 (±15) to 81 (±13) points ($p \leq 0.001$). With the exception of a flexor tendon rupture, distant to the injection side, no major complications were observed. In 46% of the cases extension was not completely possible. The overall regeneration time lasted about 3 weeks.

Discussion: The overall results match published results in the literature in most domains. The best indication is the isolated, untreated cord which affects solely the MP joint. The most disappointing results are seen in PIP joint contractures especially in the fifth finger and in recurrent disease. Even big skin defects healed uneventfully and did not require further treatment. With increasing experience the indication and treatment modalities were modified. Overall patients were pleased with the results but according to the observations, a higher recurrence rate than previously reported, must be suspect. Therefore it is mandatory to collect data for further evaluation of long-term results.

FM 72

Anatomical reconstruction of distal radioulnar ligaments with tendon graft for treating distal radioulnar joint Instability

Dr. Daniela Meyer, Zürich/CH

Introduction: Among the various reasons for chronic posttraumatic ulnar-sided wrist pain, instability of the distal radioulnar joint (DRUJ) has recently received major attention and finally achieved fundamental understanding thanks to anatomical and biomechanical studies. One and the most dramatic surgical technique consists in the replacement of the main ligamentous stabilizer of the DRUJ, the so-called TFC, with a tendon graft.
Methods: 48 patients (27 females, 21 males), mean age of 33 (14–62), with TFCC lesions received an anatomic reconstruction of the DRUJ. After creating the radial and ulnar bone tunnel the gained tendon graft (palmaris longus, FCU or toe extensor tendon) is pulled through the bone tunnels and attached in neutral forearm rotation. If necessary a concurrent corrective ulnar shortening osteotomy is performed. Immobilization in a neutral or supinated long arm cast is maintained for 4–8 weeks. Active-assistive motion exercises are allowed from the 7th week on.
Results: Out of 48 unstable DRUJ's stability was restored in 44 patients associated with a significant pain relief by 1.44 points (scale 0–4). There was however a loss of forearm rotation of 20° in average (pronation –8°, supination –12°), whereas the range of motion of the wrist and grip strength remained unchanged. We didn't find any influence on the result from simultaneous ulnar shortening osteotomy, the duration of cast immobilization or the positioning in the cast. Interestingly patients with a flatter/ less concave sigmoid notch displayed more preoperative instability, supination and flexion. There were no postoperative complications, four failed cases needed secondary procedures (2x re-reconstruction, 2x Sauvé-Kapandji-operation).
Conclusion: Our clinical study allows the conclusion that anatomical reconstruction of the distal radioulnar ligaments is an effective, safe and reliable method for restoring the stability of the DRUJ. Being retrospective, without standardized follow-up's and examiners, and upon a non homogeneous patient cohort, our study carries several limitations and weaknesses.

FM 73

Oil in situ: properties and challenges of a fluid foreign body. A case report of high-pressure oil injury to the hand with late-onset symptoms

Dr. Michael Stalder, Hôpital cantonal Fribourg, Fribourg/CH; Dr. Edouard Stauffer, Promet SA, Laboratoire médicale, Fribourg/CH; Prof. Dr Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH; Dr. Philippe Vial, Hôpital cantonal Fribourg, Fribourg/CH

Introduction: High-pressure injuries to the hand are a rare but serious entity, usually requiring urgent and aggressive debridement. While gases and water-soluble agents are eliminable, oils may be difficult to address surgically, making residual foreign material likely. To the best of our knowledge the in-situ behavior of mineral oil over the long term has not yet been described. The purpose of this case report is to highlight diagnostic properties and the value of surgery for a patient with symptoms at long-term follow-up.
Methods: We present a case with successful initial treatment including aggressive debridement after a high-pressure injury to the hand involving hydraulic oil. After five years of symptomless professional activity as a mechanic the patient presented with new onset symptoms. Swelling and pain in the affected hand were triggered by a period of dependency on crutches due to a knee operation. Magnetic resonance imaging showed excessive inflammatory activity at the affected thenar, with a nodular tissue structure subcutaneously. A biopsy of a single swollen lymph node at the ipsilateral cubital fossa confirmed the presence of oil remnants. Debridement of the first commissure of the affected hand resulted in the removal of a cumulative mass measuring 7.5 x 5 x 1.5 cm. The histological workup with a specific lipophilic coloration (oil red and hematoxylin eosin) was performed on fresh frozen tissue simples. Microscopy showed dense connective tissue interspersed with foreign body granulomas containing oil-filled vacuoles, typical multinucleated foreign body giant cells and macrophages containing foamy vacuoles. The follow-up 6 months after the last debridement showed unlimited functionality of the hand.
Conclusion: Mineral oil should be considered as a foreign body not eliminated spontaneously. Granuloma formation may lead to a steady state with low inflammatory activity, but late-onset symptoms are possible at any time. Diagnostic biopsies of the affected tissue or adjacent lymph nodes may help to confirm the presence of residual oil if a specific histological workup on fresh frozen tissue is performed. Debridement in the late phase is technically challenging due to the consistency of the scar. However, surgery may be effective in eliminating oil remnants.

FM 74

The smartphone, a new tool to determine elbow range of motion?

Dr Frédéric Vauclair, Centre hospitalier universitaire de Lausanne, Lausanne/CH; Patrick Goetti, Lausanne University Hospital, Lausanne/CH; Fahad Abduljabbar, McGill University/CA; Abdulaziz Al-Jurayyan, McGill University/CA; Bardia Barimani, Imperial College London/GB; Fiona Houghton, McGill University/CH; Prof. Dominique Rouleau, University of Montreal/CA; Prof. Edward Harvey, McGill University/CA

Introduction: When assessing functional outcomes in orthopedics, acurate measurment of joints range of motion is required. Universal goniometer (UG) is a cheap and validated method measuring elbow range of motion (ROM). Nonetheless low cost smartphone applications (SA) have emerged as an easily accessible tool for orthopedic surgeons. To our knowledge, there is no published study evaluating the validity of a (SA) in determining elbow ROM in comparision with UG, eye-balling (EB) and X-ray (XR) measurement.
Methods: We included 20 patients (11 females, 9 males) at one year of unilateral olecranon fracture fixation, mean age was 52 years (range 21–74). Lateral X-rays in maximal extension (E) and flexion (F) with the arm resting flat on the examination table were obtained for both sides (40 elbows). Measurements were taken according to Chapleau's description. F, E, pronation (P) and supination (S) were measured by a single examiner.Clinically, by EB, then with UG and finally with the SA (Clinometer). In the SA group, patients had their arm resting flat on a table.SA was set to zero and patient was asked to do maximal elbow F. For patients lacking full E, the SA was set to zero on the table and the smartphone was brought parallel to the forearm and the value was measured. For P and S, we asked patients to have a ruler in the hand and the device was aligned with it, all measurements were taken three times, and the average was calculated.
Results: We used paired samples test (PST) to evaluated accuracy compared to UG. There were no statistically significant difference for XR F measurement with a mean difference of 2.8° (±9.6). While SA overestimated F with a mean difference of 6.4°(±6.3), EB underestimated it by a mean of –7.9° (±6.9). For E, the mean difference was –1.8 ± 5.0° for SA, 2.8 ± 4.0° for EB and –26.8 ± 18.9° for XR. All methods significantly differed from UG. S accuracy was greater with EB (2.7 ± 10.5°) than with SA (5.9 ± 11.1°).PST failed to show any significant difference for P measurement with both EB (0.6 ± 6.5) and SA (–1.9 ± 7.4).
Conclusion: Despite that UG is a validated method of measuring elbow ROM, most surgeons use EB only in their daily practice. Our results showed that EB is only accurate for P and S. For the other planes of motion, it differed significantly from UG. Surprisingly, SA was not as accurate as we expected exept for P. Nonetheless, we found it to be very usefull to measure the elbow's full arc of motion when measured free in the air.

FM 75

Haptic assessment of bone quality: is there a consensus and can it be trained?

Dr. Vilijam Zdravkovic, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Sven Tulner/CH; Prof. Dr. Bernhard Jost, Kantonsspital St. Gallen, St. Gallen/CH

Introduction: New stem free designs of shoulder prosthesis are promising developments but, rely on good bone quality. Orthopaedic surgeons ultimately need to estimate the bone quality after resection of the humeral head and therefore, tactile perception (haptic) might be decisive. However, the question emerges: how hard or soft should "adequate" bone feel in order to implant a stem free prosthesis. Development of intra-operative tools for assessment of bone quality is technologically difficult. If haptic assessment should prove to be possible, surgical treatment could be optimized. The purpose of this study was to find if there is a consensus between orthopaedic surgeons on haptic assessment of the bone quality, and if the haptic assessment can be trained to be consistent between surgeons.
Methods: Forty staff members from our department with different level of experience (13 senior orthopaedic surgeons, 18 residents, and 10 students) were included in the study. As the first step, all participants were asked to press on a pinch dynamometer the particular amount of pressure that normal cancellous bone must withstand if stem free shoulder prosthesis should be implanted. The measurement was blinded and repeated 3 times. The thumb area has been measured from the fingerprint using ImageJ software. The second step was learning experience where each participant could practice unblinded how the pressure of 1.7 kg/cm^2 "feels". Two to 7 days later, the blinded testing was repeated, but the subjects were asked to pressure exactly the amount they "learned" to press in the second step.
Results: The averaged pressure of all participants was 1.67 kg/cm^2. The pressure at initial measurement did not correlate to level of experience, sex and body weight, and there was no consensus on how good bone quality should feel. After learning to press a particular pressure, the experienced surgeons were significantly more consistent then less experienced (residents). This difference was even more pronounced when compared to students.
Conclusion: There is no consensus between orthopaedic surgeons on how hard or soft a good bone quality should feel when pressed with a thumb. However, if a reference value should be known, a training of haptic perception would lead to more uniform assessment and more consistent decision making between surgeons. The more experienced surgeons seem to be able to learn and applicate haptic assessment better than the less experienced.

FM 76

Allograft reconstruction for the proximal humerus – does it work?

Dr. Daniel Andreas Müller, Uniklinik Balgrist, Zürich/CH; Dr. Giovanni Beltrami, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Dr. Guido Scoccianti, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Dr. Francesca Totti, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Prof. Rodolfo Capanna, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT

Introduction: Large bone defects of the proximal humerus after tumour resections or complicated revision surgeries are challenging situations. For restoring the proximal humerus an osteoarticular allograft (OA) or an allograft-prosthetic composite (APC) can be used. The possibility of attaching host ligaments, muscles and the capsule to the graft provides a potential stable and well functioning shoulder joint. But it has to be considered that the achievement of better functional results may be at the expense of a higher complication and revision rate.
Methods: A consecutive case series of 53 allograft reconstructions for the proximal humerus from June 1996 to December 2013 was retrospectively reviewed. The indication of the surgery was in all cases a resection of bone tumour, with an average bone loss of 12.1 cm (range 5–23 cm). An APC with an anatomical prosthesis was implanted in 12 patients, with a resurfacing device in 10 patients and with a reverse prosthesis in 13 patients. The remaining 18 patients received an OA without any joint replacement. The mean age at the time of surgery was 31.7 years (range 8–76).
Results: After a mean follow-up of 60.6 months (range 4–163) 10 allografts (18.9%) had to be revised surgically, 6 in the OA group and 4 in APC with a reverse shoulder prosthesis. The main reasons for revision were fracture of the allograft (n = 4), pseudarthrosis between host bone and allograft (n = 2) as well as aseptic loosening of the stem (n = 2), followed by infection (n = 1) and instability (n = 1). In 8 out of these 10 cases the allograft has to be removed. The allograft / implant survival for OA was 77.8% after 5 years and 68.1% after 10 years respectively. A radiographic degeneration of the joint surface was observed in 3 cases (16.7%). The APC in combination with anatomical prosthesis or resurfacing showed no failures, resulting in a 100% 10-year survival. However, the APC using a reverse prosthesis had a lower survival rate of 50.9% after 10 years (p = 0.25).
Discussion: Despite various possible complications, OA and APC are valid methods for the reconstruction of extensive bone loss in the proximal humerus. Compromise of long-term stability by fracture or non-union was the most frequent problem in this series. The use of APC further improves this aspect and avoids cartilage degeneration as seen in OA. But APC together with reverse shoulder prosthesis should be carefully considered as they show the poorest long-term survival.

FM 77

Analysis of adherence and applicability of St. Gallen algorithm for proximal humerus fractures

Jan Meester, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Christian Spross, Kantonsspital St. Gallen/CH; Dr. Vilijam Zdravkovic, Kantonsspital St. Gallen, St. Gallen/CH; Prof. Dr. Bernhard Jost, Kantonsspital St. Gallen, St. Gallen/CH

Introduction: Proximal humerus fractures are common injuries showing different patterns. Decision making is difficult as there are many patient related factors to be regarded, but also because evidence based recommendation are sparse and fragmented. We condensed the current state of knowledge into one algorithm that should provide clear decision strategy for all patients admitted to our hospital for a proximal humerus fracture. The aim of this study was to prove if the algorithm is applicable in a daily practice. Furthermore, the adherence to the algorithm and causes for divergence, have also been analysed.
Methods: We prospectively applied the algorithm for all patients admitted to our emergency unit starting from 1.1.2014. After one year the prospectively collected data set was checked for consistency, and the missing data completed retrospectively. Apart from descriptive statistics, we analysed the causes for not entering the algorithm, changing the path within, or leaving the algorithm before the therapy could be terminated. We use R statistical package.
Results: During the observation period of 1 year, 120 patients were considered for application of the algorithm, but 6 did not fulfil the inclusion criteria. Out of 114 patients there were 26.3% male (mean age 60.4 y) and 73.7% female (mean age 68.9 y). According to Neer classification, we rated 23.9% of cases as 3 or 4 part humeral head fractures. Conservative treatment was initiated in 55.8%, an operation performed in 44.2% of patients. In the operative group we performed an osteosynthesis in 42.1%, and a prosthetic replacement in 57.9%. The study protocol could not be applied to the end (non-adherence) in 8% of cases, mainly because of degraded mental status. Until now there were 6% of patients changing the therapy path in the algorithm (e.g. ostesynthesis to prosthesis).
Conclusion: The St. Gallen algorithm seems to be an applicable tool for management and decision making. The adherence to the protocol is high, and switching the paths in the protocol was rare. The impact of the algorithm on clinical outcome will be reported after adequate follow-up period has been reached.

FM 78

Reverse Total Shoulder Arthroplasty for acute, complex fractures of the proximal humerus in the elderly

Dr. Florian Grubhofer, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. med. Christian Gerber, Universitäsklink Balgrist, Zürich/CH; Prof. Dr. Dominik Meyer, Universitäsklink Balgrist, Zürich/CH; Dr. Karl Wieser, Universitätsklinik Balgrist, Zürich/CH; Dr. Silvan Beeler, Bürgerspital Solothurn, Solothurn/CH; Dr. Ulf Riede, Bürgerspital Solothurn, Solothurn/CH

Background: Anatomic reduction and internal fixation of complex proximal humerus fractures in the elderly with poor bone quality is challenging and not always possible. Secondary displacement, screw perforation and humeral head necrosis and collapse are common. Outcome of humeral head replacement is strongly dependent on tuberosity healing and not consistently satisfactory. Therefore the use of reverse total shoulder arthroplasty (RTSA) warrants consideration. The present multicenter study retrospectively analyzes mid-term results of RTSA as primary treatment of complex proximal humeral fractures.
Methods: 52 consecutive, acute, complex factures of the proximal humerus in 51 patients of a mean age of 78 (58–89) years were

treated with RTSA and reviewed clinically (constant score and subjective shoulder value) and radiologically after a mean follow-up of 35 (12–90) months.
Results: There were no intraoperative complications. Revision surgery was necessary in four patients, once for postoperative hematoma, once for a traumatic periprosthetic fracture and twice for periprosthetic infections. At final follow-up the absolute and relative Constant score averaged 62.1 points (range, 21–83) and 86% (range, 30–100) respectively, with a mean subjective shoulder value of 82.5% [range, 30–100]. 35 patients subjectively assessed outcome as excellent, 13 as good and four as fair.
Conclusion: RTSA after complex fracture of the proximal humerus in the elderly has been a very satisfactory procedure with complication and revision rates comparable or lower than for alternative treatments. The postoperative recovery is rapid and the clinical outcome is predictably and consistently good if complications which need removal of the prosthesis are avoided.

FM 79

VariAx Clavicle Locking Plate System: Clinical and radiological outcome following treatment of clavicle fractures using a new anatomically shaped plate system

Reto Fuhrer, Biel/Bienne/CH

Abstract: VariAx Clavicle Locking Plate System: Clinical and radiological outcome following treatment of clavicle fractures using a new anatomically shaped plate system.
Introduction: The anatomic shape of the clavicle raises difficulties achieving basic principles in fracture management such as anatomic re-alignment as well as stable fixation. The aim of this investigation was to evaluate the introduction of the new precontoured VariAx Clavicle Plate System in the treatment of clavicle fractures.
Methods: We undertook a retrospective review of all patients with a clavicle fracture who were treated with a VariAx Clavicle Locking Plate osteosynthesis in our hospital. Between 2012 and Dezember 2014, 70 clavicle fractures were stabilized with this new anatomically shaped plate system. Postoperative follow-up was performed as standard at 6 weeks, 3 months postoperative and until union was clinically and radiographically assessed. We evaluated intraoperative need for contouring the plate, anatomical fit, postoperative shoulder function, plate discomfort, infections and need for implant removal.
Results: In our series, no need for prebending the plate was documented. Good intraoperative fit of the plate was achieved with the precontoured plate system. Complications were one superficial wound infection with need for wound revision, one revision following non-infected hematoma and one secondary loss of reduction because of surgical implantation fault. In this case, reosteosynthesis (VariAx Clavicle Plate) showed sufficient stability and union was clinically and radiographically achieved. In five cases, removal of the plate was requested by the patient because of subjective plate discomfort.
Conclusion: With the new anatomically shaped VariAx Clavicle Locking Plate System good anatomical reduction without need for plate-prebending could be achieved in all our cases. The method showed good results with no major complication, it provided sufficient stability and satisfactory clinical outcomes.

FM 80

Comparison of arthroscopic and open Latarjet with learning curve analysis

Dr Gregory Cunningham, Hôpitaux Universitaires de Genève, Genève/CH; Dr Samy Benchouk, Centre Hospitalier Universitaire Vaudois, Lausanne/CH; Dr Omar Kherad, Genève/CH; PD Dr Alexandre Lädermann, Hôpital de La Tour, Genève/CH

Background: Arthroscopic Latarjet is a procedure on the leading edge of modern shoulder surgery, which has attracted many experimented arthroscopic surgeons by its challenging technical complexity. Although the promoters of this technique have advocated many theoretical advantages, the learning curve is still arduous, strewn with pitfalls and serious complications.
Purpose: To compare arthroscopic and open Latarjet performed by a single shoulder surgeon and analyse the learning curve.
Study Design: Retrospective comparative analysis of a prospectively gathered patient database.
Methods: Comparative analysis of arthroscopic and open Latarjet procedures performed by a single shoulder specialist surgeon between 2008 and 2014 and analysis of the learning curve of arthroscopic Latarjet, based on a patient database including parameters such as patient characteristics, ISIS scores, operative time, peroperative and postoperative complications, graft and screws positioning, and preoperative and postoperative Walch-Duplay scores.
Results: This study included 57 patients, 21 in the arthroscopic group and 36 in the open group, with a mean follow-up time of 6.6 months. Mean age was 26.6 years old and was similar in both groups, as well as sex ratio and preoperative ISIS score. Operative time and postoperative complication rate in the arthroscopic group were double that of the open group, while screw position was significantly more accurate in the open group. Postoperative Walch-Duplay score was 85.5 in the arthroscopic group and 90.7 in the open group, and the mean gain compared to preoperative scores was higher in the open group (63 versus 41.5). The learning curve of arthroscopic Latarjet analysis yielded many trends in terms of peroperative conversions, complications and outcome reliability, indicating that it takes ten patients to acquire proper technique standardization.
Conclusion: Few authors have already published about their learning curve, but this is the first study to compare arthroscopic Latarjet to the open technique. Although it seems it takes ten patients to overcome most of the arthroscopic Latarjet learning curve, it takes over the double to achieve comparable results to the open technique, which hence remains the Gold Standard.

FM 81

Arthroscopically assisted "Bipod" coracoclavicular and acromioclavicular ligament reconstruction restores vertical and horizontal stability in high grade acromioclavicular joint separations

Dr. Johannes Weihs, Orthopädie und Traumatologie, Universität Bern, Bern/CH; PD Dr. Matthias Zumstein, Inselspital Bern, Bern/CH; Benedikt Ambühl, Orthopädie und Traumatologie, Universität Bern, Bern/CH; Dr. Michael Schär, Orthopädie und Traumatologie, Universität Bern, Bern/CH; Dr. Beat Moor, Orthopädie und Traumatologie, Universität Bern, Bern/CH

Introduction: Complete acromioclavicular (AC) joint separations lead to vertical (coracoclavicular = CC) and horizontal (acromioclavicular = AC) instability of the AC joint. Over 80 different surgical procedures have been described, most of which address either the vertical or horizontal instability. The newly developed arthroscopically assisted Bipod Stabilization technique addresses both the vertical and horizontal instability by augmentation of the CC- and AC-ligaments in anatomical position using a polyester tape (Xiros Neoligament, Leeds, UK), which acts as a synthetic scaffold and a nonabsorbable Fibertape (Arthrex, Naples) for the required stiffness to the repair.
Methods: Twenty-one patients (2 women/19 men, mean age 40.2 years) with an AC joint separation Rockwood type III with horizontal instability (6 patients), type IV (1) and V (14) were included in this prospective study. These patients were subdivided into an acute (<3 weeks, 15 patients) and a chronic group (6 patients). Clinically, the Subjective Shoulder Value (SSV), the Constant Score (CS), the TAFT Score (TS) and the ACJI Score were used 3, 6 and 12 months postoperative. Vertical and horizontal instability were assessed radiographically using a Panorama view and bilateral Alexander views respectively.
Results: There was one case of a superficial infection. After a mean follow-up of 12.3 months the SSV averaged 91.9% in the acute group and 86.3% in the chronic group ($p = 0.01$). None of the following clinical or radiographic parameters showed statistical significance. The mean CS was 91.5 points (96.7%) in the acute group and 84.6 (91.8%) in the chronic group. The mean TS reached 10.8/12 points (acute) and 9.8 points (chronic). The average of the ACJI was 90.7/100 points in the acute and 85.2 points in the chronic group. The mean coracoclavicular distance was 11.8 mm on the operated side versus 10.3 mm on the contralateral side. 19.0% of all patients (4/21) had a minimal loss of reduction and showed a tendency to inferior results. Radiological signs of horizontal instability were observed in 14.3% of all cases (3/21).
Conclusion: In both acute and chronic instabilities, arthroscopically assisted "Bipod" coracoclavicular and acromioclavicular ligament reconstruction yields excellent and good clinical and radiographic results. Both vertical and horizontal stability maintained over 12 months.

FM 82

Is the acromioclavicular osteoarthritis in the MRI clinically relevant?

Dr. Holger Grehn, Kantonsspital Graubünden/CH; Janick Willi, Universität Basel/CH; PD Dr. Arno Frigg, Kantonsspital Graubünden, Zürich/CH

Background: Although the magnetic resonance imaging (MRI) scanning of the shoulder often reveals advanced diseases of the acromioclavicular (AC) joint, there are few references to its associated clinical findings. The purpose of this study was to compare the MRI appearance of the AC joint with the clinical findings.
Methods: The MRI scans of 156 patients were retrospectively reviewed and compared with their clinical findings. Nine variables were studied: in the MRI enhancement signal in the clavicle or in the acromion and AC joint abnormalities; as clinical signs palpation of the AC joint, bodycross adduction test and constant score (CS); subjective CS-Visual Analog Scale for pain; the age and gender of the patients.
Results: The only statistically significant correlation ($p = 0.03$) was between high signal in the distal clavicle and the CS-Visual Analog Scale. No other significant relationship was found between any of the other MR findings and the clinical picture.
Conclusion: High signal in the distal clavicle appears to be the only reliable predictor of symptomatic AC pathology. All other MRI appearances of the AC joint do not correlate with the clinical findings. In conclusion we decided that the AC joint resection will be only performed on patients with clinical symptoms and after positive infiltration test.

FM 83

The influence of radiographic viewing perspective and demographics on the Critical Shoulder Angle

Dr. Thomas Suter, Department of Orthopaedics, Orthopaedic Research Laboratory, University of Utah, Salt Lake City, UT, USA; Department of Orthopaedic Surgery, Kantonsspital Baselland, Liestal, Switzerland, Rheinfelden/CH; PD Dr. Ariane Gerber Popp, Department of Orthopaedic Surgery, Kantonsspital Baselland, Liestal, Switzerland/CH; Yue Zhang, Division of Epidemiology, Department of Internal Medicine, University of Utah, Salt Lake City, UT, USA/US; Chong Zhang, Division of Epidemiology, Department of Internal Medicine, University of Utah, Salt Lake City, UT, USA/US; Robert Z. Tashjian, Department of Orthopaedics, Orthopaedic Research Laboratory, University of Utah, Salt Lake City, UT, USA/US; Heath B. Henninger, Department of Orthopaedics, Orthopaedic Research Laboratory, University of Utah, Salt Lake City, UT, USA; Department of Bioengineering, Scientific Computing and Imaging Institute, University of Utah, Salt Lake City, UT, USA./US

Introduction: Accurate and reliable assessment of the critical shoulder angle (CSA) is important in clinical evaluation of osteoarthritis and degenerative rotator cuff tears. This study analyzed the influence of radiographic viewing perspective on the CSA, developed a classification system to identify malpositioned radiographs, and assessed the relationship between the CSA and demographic factors (glenoid size, gender and side).
Methods: Glenoid height, width and retroversion were measured on 3D CT reconstructions of 68 non-pathologic cadaver scapulae (60 ± 10 years). A digitally reconstructed radiograph of each scapula was aligned perpendicular to the scapular plane, and retroversion was corrected to obtain a true antero-posterior (AP) view. In 10 scapulae, incremental anteversion/retroversion and flexion/extension views (±5°, ±10°, ±15°, ±30°, ±15° compound perspectives) were generated. The CSA was measured in 268 images (68 true AP views and 200 altered perspectives). A clinically applicable classification system was developed to detect views with >2° change in CSA versus true AP. A linear mixed-effects model compared differences in CSA with respect to views and demographic factors.
Results: The average CSA was 33±4° for 68 true AP images. Intra- and inter-observer reliability was high near AP views (ICC ≥0.81) but decreased with increasing viewing angle. Views beyond 5° anteversion, 8° retroversion, 15° flexion and 26° extension resulted in >2° deviation of the CSA compared to true AP. The classification system was capable of detecting aberrant viewing perspectives with sensitivity of 95% and specificity of 53%. The CSA in 2D radiographs could be measured with less than 2° error compared to the true AP view, provided that there is no double contour of more than 50% of glenoid height or a double contour initiated at the upper glenoid less than 50% of glenoid height. Correlations between glenoid size and CSA were small ($R \leq 0.3$), and CSA did not vary by gender ($p = 0.426$) or side ($p = 0.821$).
Conclusion: The average CSA measured herein is comparable to prior reports, and was most susceptible to scapula malposition in anteversion and retroversion. The CSA measurements showed significant differences from true AP with malposition of only 5°, illustrating the importance of correct alignment of the scapula during x-ray examination. The new classification system can refine the ability to collect true AP radiographs. The CSA was unaffected by glenoid size, gender and side.

FM 84

7 year outcomes of open inferior capsular shifts in adolescent athletes with ligamentous hyperlaxity and Ehlers-Danlos syndrome

Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; Dr. Frances Tepolt, Children's Hospital Boston, Harvard Medical School/US; Prof. Dr. Mininder Kocher, Children's Hospital Boston, Harvard Medical School/US

Introduction: The objective of this study was to assess the outcome of open anterior capsular shifts for multidirectional shoulder instability in patients with ligamentous hyperlaxity and Ehlers-Danlos syndrome.
Methods: With IRB approval, data on 18 open inferior capsular shifts in 15 adolescent patients with hyperlaxity or Ehlers-Danlos with a mean follow-up of 7.5 years were obtained. Endpoints were subjective clinical outcome (pain, stability, satisfaction, return to sport), objective clinical outcome (recurrence, complications), and clinical scores (ASES, QuickDASH). Potential confounders were recalled number of prior dislocations, genetic diagnosis of EDS, and laterality.
Results: 13 patients (87%) reported improved pain and stability and were satisfied with the procedure. 9 patients (64%) were able to return to sports. 1 patient (7%) was dissatisfied with continuous pain and recurrent instability and considered a surgical failure. 7 patients (47%) reported no further episodes of instability. The mean ASES score at 7.5 years on average was 88 ± 10 pts, the mean QuickDASH score was 14 ± 14 pts.
Discussion: Our data shows that inferior capsular shifts will produce predictable improvement in subjective and objective shoulder function and stability in adolescent patients with ligamentous hyperlaxity or Ehlers-Danlos over a 7.5-year follow-up. These outcome as well as recurrence rates are in line with the literature for patients with normal soft tissue competence. We found no effect of the recalled number of prior dislocations, laterality, and type of hyperlaxity on subjective and objective clinical outcomes.

FM 85

Screw or plate arthrodesis of the glenohumeral joint: is there a difference in clinical outcome?

Dr. Gabor Janos Puskas, Kantonsspital St. Gallen, St.Gallen/CH; PD Dr Alexandre Lädermann, Hôpital de La Tour, Genève/CH; Dr. Stefanie Hirsiger, Uniklinik Balgrist, Zürich/CH; Prof. Dr Pierre J. Hoffmeyer, Hôpitaux Universitaires de Genève/CH; Prof. Dr. med. Christian Gerber, Universitätsklinik Balgrist, Zürich/CH

Introduction: There is no biomechanical advantage of glenohumeral arthrodesis with screw compared with plate fixation. Nonetheless, there is a trend in the literature toward utilization of screw fixation alone. However, there is no comparative study of screw and plate arthrodesis.
Methods: We performed a retrospective multicentric review of all glenohumeral arthrodeses performed from January 2000 to March 2012. The cohort was divided into two groups based on the technique to compare the clinical and radiological outcome with special focus on revision rate and patient satisfaction. Additionally, number of screws and placement were analyzed.
Results: Arthrodesis was performed in 18 male and 15 female patients with a mean age of 50 (16–85) for a neurological diagnosis (6), pseudoparalysis (3), instability (9), Infection (12) or a posttraumatic condition (3). In 7 cases screws alone were used and in 26 cases a plate arthrodesis was performed. At final follow-up of 43 (11–152) months 80% of the patients were satisfied. The subjective shoulder value (SSV) increased significantly from 20 (0–70)% to 40 (10–80)% ($p = 0.02$). The relative Constant score (CS%) (22 (3–74)% preoperatively and 24 (11–50)% postoperatively) did not change, but its subscore for pain increased from 5 (0–15) to 11 (6–15) ($p = 0.003$). The two groups did not differ in terms of demographic data, preoperative relative CS ($p = 0.303$), follow-up time ($p = 0.833$), postoperative final satisfaction rate, SSV ($p = 0.482$) and relative CS ($p = 0.582$). In 13 patients (39%) the arthrodesis had to be revised either for malposistion (3) or non-union (10) at 12 (0–47) months. There were more revisions after

screw than plate fixation (71% vs. 44%; p = 0.084) and the rate for revision performed for non-union was significant (71% vs. 24% p = 0.016). Plate arthrodesis ultimately requiring revision for non-union had fewer screws in total (8.7 (8–10) vs. 9.6 (7–12)) and across the glenohumeral joint (1.9 (0–3) vs. 2.3 (1–4)) compared with healed arthrodeses, however these differences were not statistically significant (p = 0.638 and 0.587).
Conclusion: Arthrodesis of the glenohumeral joint can achieve an at best reasonable satisfaction rate but significantly reduces pain in selected patients requiring a salvage operation. Fusion and revision rates favor plate over isolated screw fixation.

FM 86

Surgical accuracy of humeral head osteotomy in shoulder arthroplasty

Dr. Thomas Suter, Department of Orthopaedics, Orthopaedic Research Laboratory, University of Utah, Salt Lake City, UT, USA; Department of Orthopaedic Surgery, Kantonsspital Baselland, Liestal, Switzerland, Rheinfelden/CH; Christopher W. Kolz, Department of Orthopaedics, Orthopaedic Research Laboratory, University of Utah, Salt Lake City, UT, USA/US; Sean T. Tagge, Department of Orthopaedics, Orthopaedic Research Laboratory, University of Utah, Salt Lake City, UT, USA/US; Robert Z. Tashjian, Department of Orthopaedics, Orthopaedic Research Laboratory, University of Utah, Salt Lake City, UT, USA/US; PD Dr. Ariane Gerber Popp, Department of Orthopaedic Surgery, Kantonsspital Baselland, Liestal, Switzerland/CH; Heath B. Henninger, Department of Orthopaedics, Orthopaedic Research Laboratory, University of Utah, Salt Lake City, UT, USA; Department of Bioengineering, Scientific Computing and Imaging Institute, University of Utah, Salt Lake City, UT, USA/US

Introduction: The principles of humeral head reconstruction in shoulder arthroplasty (SA) are based on the assumption that the articular segment resected along the antero-superior anatomic neck corresponds to a segment of a sphere oriented, identically, in inclination and retroversion to the original humeral head. Surgical accuracy in implementing computer optimized humeral head osteotomies for SA remains unclear. We hypothesized that the orientation of the osteotomy plane, and the geometry of the resected head, would not differ between a virtually and surgically performed osteotomy (VPOT, SPOT), or the native anatomy.
Methods: The anatomic neck and humeral head cartilage were digitized in 8 human cadaver shoulders. All collected data were referenced back to 3D CT reconstructions of each specimen through coordinate transformations defined by marker clusters attached to the humeri and graphically modeled. A VPOT based on the antero-superior anatomical neck was performed in the model and the cadaver was osteotomized using the same landmarks. The resected head and cutting plane were then digitized. Osteotomy orientation (inclination, retroversion) and geometry (head height, length, width, width-length-ratio, RMS error calculated as the deviation between the geometry of the resected humeral head and a portion of a sphere taken at the same resection plane) were compared between the VPOT, SPOT, and native anatomy.
Results: The mean difference between the VPOT and SPOT was 3 ± 3° for inclination and 6 ± 5° for retroversion (p ≥0.112). Only head height (VPOT +3 ± 2 mm) and RMS error (VPOT +0.7 ± 0.6 mm) differed (p ≤0.009). Both VPOT and SPOT decreased inclination (–6 ± 3°, –5 ± 3°, p ≤0.002), and increased retroversion (+15 ± 5°, +11 ± 6°, p ≤0.001) versus native. Only head height (+3 ± 1 mm) and RMS error (+0.5 ± 0.6 mm) (p ≤0.034) increased for VPOT versus native.
Conclusion: Humeral head osteotomies during SA can be performed accurately versus idealized resections, but the orientation of the osteotomy using the broadly recommended reference along the antero-superior anatomic neck differs significantly compared to the native anatomy. Interestingly, a slightly altered osteotomy orientation resulted in a more spherical segment of the resected humeral head. Further studies should investigate how geometry of the resected humeral head influences biomechanics, and if alternative osteotomies with more spherical resected segments may improve clinical outcomes.

FM 87

Does administration of antibiotic agents before intraoperative sampling in orthopedic infections alter culture results?

Dr Philippe Alves/CH; Dr Mohamed AL-MAYAHI, Genève/CH; Dr Guillaume Racloz/CH; Dr. Hermes H. Miozzari, Genève/CH; PD Dr Domizio Suvà, HUG, Genève/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH

Purpose: Clinicians frequently withhold antibiotic agents before intraoperative sampling for infection, presuming that this will increase the likelihood of culturing pathogens. Recent reports suggest, however, that prescribing pre-sampling antibiotics does not lead to more culture-negative results.
Methods: We compared patients who did, and did not receive pre-operative antibiotic therapy. Preoperative exposure was defined as any antibiotic consumption during the 14 days prior to surgical sampling, including prophylactic exposure and patients with an antibiotic-free window of some days.
Results: Among 2400 episodes of orthopaedic infections (1059 osteoarticular, 302 prosthetic joint, 588 implant-associated, 435 septic bursitis), 1001 had received some antibiotic therapy before surgical sampling. Among these, 191 grew no pathogens while the proportion of culture-negative results in the 1399 who had no antibiotic was only 6%. Of all positive intraoperative cultures, 38% exposed to pre-operative antimicrobial agents had a resistant pathogen isolated, although the clinical course was favorable in the majority of cases. By multivariate analyses, pre-operative antibiotic exposure was associated with significantly more culture negative results and to the isolation of more antibiotic-resistant pathogens. In patients who had pre-operative antibiotics stopped, the proportion of culture-negative results was 20% between days 1–3 and reached the average for patients who did not receive pre-operative antibiotics (6%) on day 4. The proportion of culture-negative results was not significantly lower when the antibiotic–free window was longer than 4 days. 67 patients received a single pre-incisional antibiotic dose which was also significantly associated with culture-negative results compared to patients who received no prophylaxis. Moreover, in 20 of these 50 culture-positive episodes the isolated pathogen was resistant to the prophylaxis administered <1 hour before. These are mainly non-fermenting gram-negative rods and skin commensals, were isolated significantly more often in patients who had pre-operative antibiotic prophylaxis.
Conclusion: Exposure to pre-operative antibiotics, is associated with a three-fold increase in culture-negative intraoperative sampling results and selection of antibiotic-resistant non-fermenting rods and skin commensals. An antibiotic-free window of 4 days is associated with the same proportion of culture-negative results as a longer window.

FM 88

Who receives antibiotics before intra-operative microbiologic sampling for orthopaedic infections?

Dr Mohamed Al-Mayahi, Genève/CH; Dr Guillaume Racloz/CH; Dr. Hermes H. Miozzari, Genève/CH; PD Dr Domizio Suvà, HUG, Genève/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH

Purpose: Accurately determining the causative pathogens in orthopaedic infections is key for appropriately targeted antibiotic therapy. This is especially true for infections associated with the a foreign body. Intraoperative tissue samplings (and/or blood cultures) prior to antibiotic treatment is considered the gold standard approach, but preoperative prescription is frequent. To ascertain the current practice on this matter in our hospital, we evaluated in which situations antibiotics were given preoperative antibiotics.
Methods: This was a retrospective study at Geneva University Hospitals, a tertiary care hospital, on adult patients hospitalized from 2004–2014. Group comparisons were conducted using the $\chi 2$-test.
Results: We reviewed 2632 episodes of community-acquired and nosocomial orthopaedic infections, The study population had a median age of 57 years, included 828 females (31%), 311 bacteraemic cases (12%), and 980 immune suppressed patients (37%). The types of infection included 312 prosthetic joint infections, 324 fracture-device infections, 522 osteoarticular infections, 458 cases of septic bursitis, 413 neuropathic foot infections, and various soft tissue infections, including 996 abscesses. In 1120 episodes (43%) patients received antibiotic therapy (parenteral in 61%) before they had specimens for culture obtained by intraoperative sampling or blood cultures. Factors more frequently associated with preoperative antibiotic therapy were: female sex; advanced age; immune-suppression; and prosthetic-

related infections (all p ≤0.01). In contrast, factors not associated with preoperative antibiotic therapy included apparent clinical severity (e.g., later diagnosed bacteraemic cases [p = 0.42]) and soft tissue infections with abscess or purulent discharges (p = 0.30) other than neuropathic foot infections (p ≤0.01) and septic bursitis cases (p ≤0.01). The median preoperative serum CRP levels in those who did, and did not, receive antibiotics were 87 and 67 mg/L, respectively.
Conclusion: In our center over the past decade, 43% patients hospitalized with orthopaedic infections were receiving antibiotic therapy before they had proper microbiologic sampling. Surprisingly, the clinical appearance of infection severity or the presence of pus was not associated with this preoperative antibiotic prescribing. Just on the contrary, many patients needing long-term targeted antibiotic therapy.

FM 89

Body mass and weight thresholds for increased deep infection rates after primary total joint arthroplasty

PD Dr. Anne Lubbeke Wolff, Hôpitaux Universitaires de Genève, Genève/CH; Matthieu Zingg/CH; Diemlan Vu Cantero/CH; Dr. Hermes H. Miozzari, Genève/CH; Panayiotis Christofilopoulos, Genève/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH; Stephan Harbarth/CH; Prof. Dr Pierre J. Hoffmeyer, Hôpitaux Universitaires de Genève/CH

Introduction: Obesity increases the risk of deep infection after TJA. Lower serum and tissue concentrations of prophylactic antibiotics have been measured in obese, leading to possible under-dosage during surgery. Our objective was to identify BMI and weight thresholds above which deep infection rates increase in primary TJA patients treated with the same prophylactic antibiotic prior to surgery, in accordance with current guidelines.
Methods: We included all primary hip and knee arthroplasties operated between 3/1996 and 12/2013 having received cefuroxime 1.5g IV prior to surgery. Main exposures were BMI (<24.9, 25–29.9, 30–34.9, 35–39.9, ≥40 kg/m²) and weight (<60, 60–79, 80–99, 100–119, ≥120 kg). Main outcome was deep infection. Results 7,834 TJAs (mean age 69.6; 60% women) were included. TJAs according to BMI categories (lowest to highest) were as follows: 2,531, 2,885, 1,658, 566 and 194, respectively. Overall, 108 infections were observed. Incidence rates were similar among BMI categories <35, but occurred twice as often with BMI 35–39.9 (adjusted HR 2.0, 95%CI 1.01–3.9) and four times more often with BMI ≥40 (adjusted HR 4.0, 95%CI 1.7–9.2). Weight ≥100 kg was identified as threshold indicating a significant increase in infection from the early postoperative period on (adjusted HR 2.1, 95%CI 1.3–3.5).
Conclusion: The identification of differences according to severity of obesity may help to better target preventive interventions: one of them might be a weight-based dosage adaptation for antibiotic prophylaxis with cefuroxime consisting of dosage doubling with ≥100 kg. Whether the higher dose ultimately reduces the infection risk in obese patients undergoing TJA remains to be elucidated.

FM 90

French practice of prolonged suppressive antibiotic therapy in prosthetic joint infection in elderly patients

Dr Virginie Prendki, HUG, Thônex, genève/CH; Dr Emmanuel Forestier/FR; Dr Gaëtan Gavazzi/FR; Dr Thibaut Fraisse/FR; Prof. Tristan Ferry/FR; Dr Eric Oziol/FR; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH; Prof. François Herrmann/CH;Dr Aurélien, et Groupe d'Etude sur le PSAT Dinh/FR; Pauline Sergent/FR

Introduction: Prolonged suppressive antimicrobial therapy (PSAT) is a treatment of prosthetic joint infection (PJI). Our study aimed to describe the patients, their outcome, the indication and type of PSAT in elderly patients with PJI.
Methodology: Retrospective multicentric French study in departments of orthopedics, internal medicine, infectious diseases, geriatric from 2009 to 2014. Questionnaires were filled out by doctors. Inclusion criteria: >75 years, PJI treated with retention of the prosthesis and PSAT (antimicrobial therapy given to inhibit bacterial multiplication).
Preliminary results as the study is still ongoing: 86 patients, 48 women (56%); mean age: 83 [75–97]; living at home 64 (74%), nursing home 16; walking assistance 50 (58%), bedridden 8; cognitive disorders 16. WHO performance status (mean 2), Mc Cabe score (mean 1.4). Hip 50 (58%), knee 35, shoulder 1; previous PJI: 33 (39%); fistula: 25 (29%). Positive samples: intraoperative culture 43 (50%), joint aspiration 36 (42%), blood culture 14 (16%), fistula (8); monomicrobial 71 (83%), plurimicrobial (11) infection, no bacteria (4). Staphylococcus 50 (58%): S. aureus (38%) (MSSA 23, MRSA 10), Coagulase Negative Staphylococci 17; Streptococcus 13, Enterobacteria 8, Enterococcus 2, Pasteurella 2, Pseudomonas 1, Listeria 1, Corynebacteria 1, anaerobes 1. Reason for PSAT: anesthetic or surgical contraindication 43 (50%), patient/support person's refusal of surgery 29 (34%), negative benefit/risk balance 8 (10%). Advice from: infectiologist 77, reference center for PJI 49, geriatrician 8. Initial surgical intervention: 53 (62%); initial intravenous antimicrobial therapy: 61 (71%). PSAT at the onset 28 (33%); double therapy: 21 (24%). Betalactams 27 (31%): penicillins 19, cephalosporins 7, imipenem 1; Quinolones 15 (17%); Pristinamycine 15 (17%); Cotrimoxazole 13; Rifampin 11; Clindamycine 10; Fucidic acid 3. Stopped: 13 (15%), changed: 16 (19%). Mean duration: 15 months [0-84]. 71 patients (83%) still under PSAT at last contact. Outcome: death 15 (17%), satisfying therapy 76 (88%); improved mobility 37 (43%); decreased inflammation 52 (60%). 87.5% of patients were alive at 24 months. 70% of patients with S. aureus PJI were alive vs 95% for patients with other infection by the end of 2 years (p = 0.01).
Conclusion: PSAT is beneficial in selected cases but follow-up is recommended. Larger prospective and international studies are needed to determine its place and consequences.

FM 91

The place of Alpha-defensine-1 as a biomarker for the diagnosis of periprosthetic joint infection

Patrick Goetti, Lausanne University Hospital, Lausanne/CH; PD Dr Olivier Borens, Lausanne University Hospital, Lausanne/CH

Introduction: The diagnosis of periprosthetic joint infection (PJI) is often challenging due to nonspecific symptoms. The diagnosis is made using clinical criterias and biological markuers in blood or synovial fluid obtained by joint aspiration. Recently Alpha defensin-1 protein (AD-1) was proposed as a new biomarker for PJI that can be used pre- or peroperatively on synovial fluid with an immediate result. To our knowledge there is only one independant retrospective clinical study reporting promising results. We report our preleminary results using alpha-defensin in comparision with standard PJI workup including cell count, cell repartition, culture and blood CRP further we will discuss the possible place of this test in the infection work up.
Methods: Retrospective case review
Results: In 10 patients the result of the AD-1 lateral flow test corresponded in 100% to the standard microbiological and cytological (cell count and cell repartition) exams. The test was easy to use, easy to read and fast.
Conclusion: The excellent correlation between standard PJI workup and AD-1 shows the potential advantages of this easy to use test. The mean question lies in its place in the diagnostic workup. Knowing only if the prosthesis is infected or not is not giving enough information to decide on the best therapeutic option for the patient and microbiological exams will stay extremly important for the decision making. Standard cytology of the joint fluid has almost the same specificity/sensitivity as the AD-1 but is much cheaper. The interest of AD-1 lies thus probably in quick and precise intraoperative diagnosis during a 1 step exchange of a suspected non infected TJA, the testing during the second step of a 2-stage exchange and maybe in deciding when to stop antibiotic treatment in longterm antibiotic treatment after exchange operation of an infected TJA.

FM 92

Long term thermal stability of antibiotics exposed to temperatures mimicking body temperature and curing bone cement

Dr Eleftheria Samara, HUG, Morges/CH; Dr Fintan Moriarty/CH; Dr Peter Wahl/CH; Prof. Laurent Decosterd/CH; Prof. Dr Geoff Richards/CH

Introduction: Local application of antibiotics has become common practice in the treatment of bone and joint infections. Heat resistance of the antibiotic to curing of the carrier material and to body temperature during the release process is essential. Primary aim of this in vitro study was to examine heat stability of a broad range of antibiotics to exposure to 37 °C for 6 weeks. A secondary objective was to examine the effect of initial thermal exposure corresponding to bone cement polymerization.
Methods: Thirty seven antibiotics were dissolved or diluted in aqueous solution. A portion of each sample was directly incubated at 37 °C for 42 days and a portion exposed to a thermal curve mimicking the bone cement curing process, followed by incubation at 37 °C for 42 days. The remaining concentrations were measured at several timepoints

using disc diffusion tests and high-performance liquid chromatography with tandem mass spectrometry or fluorescence polarisation immunoassay.
Results: Stability to body temperature was both time-dependant and class-specific. Aminoglycosides, quinolones, glycopeptides, some macrolides, tetracycline aztreonam, trimethoprime/ sulfamethoxazol and linezolid were those with the highest long term resistance, remaining active at >75% for 42 days at 37 °C. Ticarcillin and fusidic acid remained relatively stable for up to 21 days. Cephalosporins, temocillin and colistin were shown to be unstable with antimicrobial activity rapidly decreasing within days. The remaining penicillins, glycopeptides, macrolides, carbapenems, as well as cefazolin and rifampicin showed a moderate decrease of activity at 37 °C that fell below 74.9% of starting antimicrobial activity within 7 to 14 days. The initial short-term high temperature treatment during cement curing has a limited, if any, impact on the respective antibiotics stability.
Conclusion: The initial short term temperature elevation mimicking cement curing has limited, if any, impact on antibiotics overall stability in this experiment. The excellent short- and long- term stability of aminoglycosides and glycopeptides was confirmed, supporting the current clinical use of these antibiotics. Tetracyclines and quinolones were also confirmed as stable, but local toxicity issues limit their clinical use. New agents such as ticarcillin, aztreonam, azithromycin, telithromycin, linezolid, fusidic acid and trimethoprim/sulfamethoxazole shoved enough stability for potential local application.

FM 93

Is there an association between smoking status and prosthetic joint infection following primary total joint arthroplasty

Dr Amanda Gonzalez, Hôpitaux Universitaires de Genève, Genève 14/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH; Prof. Dr Pierre J. Hoffmeyer, Hôpitaux Universitaires de Genève/CH; PD Dr. Anne Lubbeke Wolff, Hôpitaux Universitaires de Genève, Genève/CH

Introduction: Smoking has been associated with lower tissue oxygenation, poorer vascularisation and altered immune response, predisposing smokers to a higher risk for postsurgical infections. The aim of this study is to estimate the influence of smoking status on the incidence of prosthetic joint infection following primary total joint arthroplasty (TJA).
Methods: We performed a prospective hospital-registry based cohort study including all primary total knee and hip arthroplasties performed between March 1996 and December 2013 and following them until June 2014. Smoking status at time of surgery obtained from the anesthesiology report was classified in never, former and current smoker. Incidence rates and incidence rate ratios (IRR) for prosthetic joint infection according to smoking status were assessed within the first year and over the whole study period. Adjusted IRRs were obtained using competing risks regression. Adjustment using the propensity score method was performed for the following baseline characteristics: for age, sex, BMI, ASA score, diabetes, diagnosis, surgery duration and site of arthroplasty. Kaplan-Meier survival analysis was also employed.
Results: We included 7,876 TJAs, 3,103 knee (39.4%) and 4,773 hip arthroplasties. Mean age was 70 years, 61% were women, mean follow-up time was 80 months (range 6-216). 5,290 (67.2%) were never smokers (group 1), 1,215 (15.4%) former smokers (group 2) and 1,371 (17.4%) current smokers (group 3). Over the study period, 108 prosthetic joint infection occurred, 57 in never-smokers, 28 in current, and 23 in former smokers. Incidence rates of infection within one year were for group 1, 2 and 3, respectively as follows: 7.0, 13.0 and 15.2 cases/1000 person-year. Comparing ever- vs. never-smokers, the crude IRR was 2.0 (95% CI 1.3–3.2), and the adjusted IRR 1.7 (95% CI 1.01–2.8). Incidence rates for infection over the whole study period were 1.6, 3.2 and 3.2 cases/1000 person-years for group 1, 2 and 3, respectively. Crude IRR for ever- vs. never-smokers was 2.0 (95% CI 1.3–2.9) and after adjustment 1.6 (95% CI 1.02–2.4). Results were similar for current and former smokers (vs. never-smokers) and following hip and knee arthroplasty.
Conclusions: Smoking (both current and former) was associated with an about 1.5 times higher incidence rate of prosthetic joint infection following TJA. The difference was established already in the first year after surgery and did not change thereafter.

FM 94

Surgical Technique: Custom made modular megaspacer for the two-stage treatment of implant-associated infection of a total femur prosthesis

Dr. Bernhard Speth, Universitäts-Kinderspital beider Basel (UKBB), Basel/CH; PD Dr. Andreas Krieg, Universitäts-Kinderspital beider Basel/CH; Dr. Andrej Nowakowski, Universitätsspital Basel, Basel/CH

Introduction: Limb salvage surgery (LSS) with endoprosthetic replacement is a common method of reconstruction following bone tumor resection whenever there is no possibility for a biological reconstruction. Postoperative infection is the most common mode of failure. Two-stage procedures require spacers to maintain the distance and to allow for mobilisation. Due to the rarity and diversity of these cases there are no commercially available prefabricated solutions. We present a simple method for a custom made antibiotic-coated megaspacer which we successfully applied in a patient with an infected megaendoprosthesis.
Method: A 13 year old patient with high grade osteoblastic Osteosarcoma of the femur with involvement of the proximal physis underwent a wide-resection and implantation of a total femur endoprosthesis after neoadjuvant chemotherapy. During the postoperative course and adjuvant chemotherapy the patient developed a deep implant-associated infection with coagulase negative Staphylococci and Klebsiella pneumonia. The infection together with a septic shock determined the indication for the 2-step revision of the implant. After removal of the prosthesis and of the acetabular cartilage we implanted an individualized megaspacer. The head was made with a cement spacer mold and coupled with a 6 mm Harrington stainless steel rod. Under traction the modularity of the connecting element allowed optimum lenght adjustment at the trial reduction. Subsequently, the spacer was completely encased with antibiotic-loaded cement and implanted. Postoperatively the antimicrobial treatment was continued with Rocephin and Vancomycin according to the bacterial resistance.
Results: Under this therapy the patient's condition stabilized and the CRP-level normalized within 9 days. The antibiotic therapy was continued for 6 weeks followed by a 2 weeks antibiotic-free interval. Re-implantation of a total megaendoprotheses was carried out 2 weeks after cessation of the antibiotic treatment. Within 9 days the CRP level normalized. Two years postoperatively the patient was free from infection with a range of motion of 90-0-0 degrees.
Conclusion: Through its modularity the illustrated technique offers a good solution for individual adjustments for the preparation of interim prostheses especially for two-stage exchanges of megaendoprosthesis. The optimum length can easily be adjusted. Furthermore the explantation of the megaspacer before replacement of a final prosthesis is simplified.

FM 95

The necessity of surgical guidelines to work-up unknown soft tissue lesions to avoid deleterious consequences for the patient

Dr. Sabra Leupi/CH; Dr. Stephan Keller, Universitätsklinik Balgrist, Zürich/CH; Pietro Giovanoli/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Soft-tissue sarcomas are rare tumors in which a multidisciplinary approach is crucial. Unplanned removal or other invasive intervention leading to spread of tumor cells are common errors resulting in a poorer outcome. We present the case to illustrate the immense consequence of a small intervention like a joint puncture.
Case: A 42 year old male notices a painful swelling of 20 × 30 cm on the anteromedial-distal aspect of the right thigh, persistent for two months. This swelling was misinterpreted as a joint effusion and four punctures of the knee joint, three of them passing through the swelling, were performed, although no joint fluid could be aspirated. Due to persistent pain and swelling more imaging was done and the tumor was detected. In the following Ultrasound- guided biopsy a high grade pleomorphic liposarcoma was diagnosed and neoadjuvant radiotherapy initiated. Although the tumor was primarily extra-articular, the knee joint had to be regarded as contaminated due to the punctures performed previously. Therefore an extra-articular tumor resection was necessary. Treatment options in this situation were above knee amputation, tumor prosthesis which wasn't possible anymore because of the contaminated soft tissues, and rotationsplasty. After extensive discussion with the patient, we decided to perform a rotationsplasty. The lower limb was turned 180°. The femur was invaginated into the tibia and fixed with a 10-hole NCB plate. The hamstrings were attached to the foot extensors while the quadriceps was attached to the gastrocnemius. The neurovascular structures

could be preserved and were rolled up. The ankle joint takes over the function of the resected knee joint and the patient is able to walk with an orthosis without cruches and no phantom pain.
Discussion: A "small" intervention, such as puncture of the knee joint in a patient with an unknown swelling may contaminate the joint with malignant tumor cells and may have major impact on the further treatment. Therefore, it is recommended to apply the "work-up guidelines" of the Swiss National Sarcoma Advisory Board (www.sarcoma.ch). The guidelines are written in a simple easy-to-understand-way to help physicians whenever they are confronted with an unknown swelling of the locomotor system.

FM 96

Ewing sarcoma in the pelvis – a challenge for the oncologic surgeon

Dr. Daniel Andreas Müller, Uniklinik Balgrist, Zürich/CH; Dr. Giovanni Beltrami, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Dr. Guido Scoccianti, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Dr. Francesca Totti, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Prof. Rodolfo Capanna, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT

Introduction: Ewing Sarcoma has to be considered as a systemic disease and chemotherapy is therefore the mainstay of treatment. Local control can be achieved with radiation therapy, surgery or the combination of both. This study aims to highlight the complications and the oncological outcome of surgically treated Ewing sarcomas in the pelvis.
Methods: A consecutive case series of 13 patients who underwent a surgical treatment of an Ewing sarcoma located in the pelvis between 2000 and 2013 was retrospectively reviewed. 7 patients underwent a type I resection (iliac wing), 5 patients a type II resection (periacetabular region) and one a type III resection (anterior arch). After 4 type I resections and the type III resection no further reconstruction was necessary. In the remaining 3 type I resections the bone defect was replaced by a massive allograft, fixed with plate and screws to the residual pelvis. In all type II resections a massive allograft in combination with a conventional hip prosthesis was implanted to restore the hip articulation.
Results: After a mean follow up of 56.8 months 7 patients were current disease free, 2 patients were alive with disease, 3 patients died of disease and one patient showed no evidence of disease after a successful treatment of metastasis. The overall 5-year survival in our series was 73.8% (95%CI: 38.5–90.8%). No local recurrence was observed. Metastatic lesions were found in 6 patients after a mean follow up of 17 months. The disease free survival after 5 years was 54.7% (95%CI: 22.2–78.5%). In the postoperative course 3 patients suffered from sciatic nerve palsies. In 2 out of 5 patients with a total hip replacement a luxation occurred. In one of these cases the prosthesis had to be changed to improve the cup positioning. An non-traumatic fracture of an iliac wing allograft remained asymptomatic. One deep infection in a bone allograft was observed: After surgical debridement and antibiotic treatment a low grad infection persisted at the last follow up.
Conclusions: Ewing sarcoma of the pelvis has to be considered as a severe systematic disease with a high rate of metastases. Massive bone allograft for pelvic reconstruction provides a good function preserving the hip joint, but presents a high complication rate that may delay the crucial adjuvant therapy.

FM 97

3D-planned allograft reconstruction with patient specific jigs for the proximal radius of a patient with Ewing sarcoma

Dr. Marco Germann, Universitätsklinik Balgrist, Zürich/CH; Dr. Lazaros Vlachopoulos/CH;PD Dr. Andreas Schweizer, Uniklinik Balgrist, Zürich/CH; Dr. Stephan Keller, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Ewing sarcoma is the second most frequent malignant primary bone tumor with its highest incidence in adolescents and young adults. Combination therapy has become the mainstay of a multidisciplinary treatment. It is crucial to achieve a resection of the tumor with microscopically negative margins (R0-resection), surgery may often be mutilating and preservation of the limb is not always possible. The most frequent techniques for reconstruction are implantation of a mega prosthesis or allograft reconstruction. We present the case of a 29 year old female with a ewing sarcoma in the proximal radius in whom an osteoarticular allograft reconstruction was performed with preoperative 3D planning and patient specific jigs.
Case report: A 29 year old female developed a pathological fracture through an osteolytic lesion. An incision biopsy was performed, which showed Ewing sarcoma with neuroendocrine differentiation. MRI showed that the radius was affected on a length of 80 mm, starting 9 mm from the radiohumeral joint line. Staging showed no skip lesions nor other indications for metastases. After interdisciplinary discussion at the sarcoma board a multiagent neoadjuvant chemotherapy was conducted. Preoperative planning included CT scans of the affected forearm, of the healthy opposite side as a template for reconstruction and of a whole radius allograft. Ulna and radius were segmented and patient-specific drill guides were made for precise tumor resection which is crucial for oncologic reaseons as well as allograft reconstruction, including correction of radial bowing due to the pathological fracture which consolidated in the meantime. The annular ligament was preserved, because the 3D shape of the radial head of the resected radius was similar to the allograft. The drill holes for reconstruction with a 2.7 mm ulna osteotomy plate (Synthes) were also included in the jigs and allowed precise reconstruction concerning length and rotation. Postoperative pro- und supination was 80° each. The supinator muscle which covered the tumor was split to preserve the posterior interosseus nerve but mainly resected for tumor purposes.
Conclusion: Preoparative planning and patient specific jigs allow precise planning and resection of bone tumors, as well as accurate reconstruction of bone length and orientation.

FM 98

Adjuvant surgery in high grade soft tissue sarcoma of limbs: is it effective?

Dr. Daniel Andreas Müller, Uniklinik Balgrist, Zürich/CH; Dr. Giovanni Beltrami, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Dr. Guido Scoccianti, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Dr. Francesca Totti, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Prof. Rodolfo Capanna, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT

Introduction: In the current literature as well as in international guidelines, Radiation Therapy (RT) is an established treatment to improve efficacy in Local Control (LC) of High Grade (HG) Soft Tissue Sarcomas (STS). But there is still no agreement in timing, selection of cases and type of RT in the combination with surgical excision.
Methods: We retrospectively reviewed a consecutive series of 884 patients, which have been operated in one institution for a HG STS of the limb. The patients were divided according the treatment regimen in 3 groups: Group I (97 patients) was treated by NeoADJ RT and ADJ surgery; Group II (324 patients) received NeoADJ surgery and ADJ RT; whereas Group III (463 patients) has undergone surgery alone without any RT. We compared the 3 groups concerning Local Recurrence (LR), complications, metastasis and limb preservation considering risk factors such as sex, age, chemotherapy, surgical margin, size, site and histology of the lesion.
Results: After an average follow-up of 41 months 603 patients were disease free or died of other causes, 90 patients had a non-evident disease after treatment of a distant secondary lesion, 72 patients were alive with disease and 119 patients died of disease. LR was observed in a total of 115 patients after an average time of 27 months. After 15 years follow-up 43% (95%CI: 1.2–85%) of the patients in Group I showed no LR, in Group II 70% (95%CI: 51–82%) of the patients and in Group III 64% (95%CI: 50–74%) of the patients respectively. In Group I no significant association could be found between surgical margins and LR. In Group II however radical and wide resections showed less LR than intralesional and marginal resections ($p = 0.01$). As expected also in Group III adequate surgical margins provides a better local control of the disease. The occurrence of a metastatic lesion was in all groups independent from the achieved surgical margins.
Conclusions: NeoADJ RT showed the highest complication rate and tends to fail the local control after more than 10 years follow up. But on the other hand neoADJ RT minimizes the risks of surgical contamination, as the LR was not associated with inadequate margins. ADJ RT achieved the best local control after 10 years. But the NeoADJ surgery has to be effective, as LR was influenced by the surgical margins. A surgical treatment without any RT showed after all an acceptable local control. In selected cases it seems to be an alternative to avoid potential RT complications.

FM 99

Malignant bone disease of the hip treated with total hip arthroplasty

Lima Sottaz, Universität Basel, Villars-sur-Glâne/CH; PD Dr. Anne Lubbeke Wolff, Hôpitaux Universitaires de Genève, Genève/CH; Prof. Dr Pierre J. Hoffmeyer, Hôpitaux Universitaires de Genève/CH

Introduction: The prevalence of bone metastasis has increased these past years due to advances in cancer management. Patients with cancer live longer and are therefore more at risk to develop secondary malignancies. These metastases and primary bone tumors are frequently found in the hip and may need surgical treatment. We chose to focus on total hip arthroplasty although many techniques are available.
Methods: We studied retrospectively 32 cases of patients suffering from bone malignancies who underwent total hip replacement in a span of 13 years. The data were collected in the Geneva hip arthroplasty registry. We identified the surgical indications, the types of prostheses, the adjuvant therapies, the complications and the outcome of the procedure (pain management and mobilization).
Results: Fractures, unmanageable pain, painful functional deficits, high risks of fracture and the concomitant presence of osteoarthritis were all surgical indications. All surgeries were palliative. The choice of a total hip prosthesis was made in the presence of articular lesions or if any other type of fixation had failed. Twenty patients benefited from a primary cemented total hip prosthesis and twelve patients received a hybrid primary prosthesis (uncemented cup with cemented stem). Sixteen patients received no adjuvant treatment. Of the sixteen remaining patients, six were treated with additional chemotherapy, six others with radiotherapy and four benefited from both treatments. No typical complication such as infection, dislocation, aseptic implant loosening or venous thrombosis was reported, but two partial injuries of the sciatic nerve have been described. The procedure allowed pain management for twenty-seven cases. Postoperatively, all patients were able to move from bed to chair and were comfortable with the sitting position with the usual painkillers. Twenty-nine were able to begin rehabilitation therapy and said to be satisfied at the 6 weeks postoperative visit.
Conclusion: These data suggest that total hip replacement is beneficial in terms of autonomy gain and pain reduction and has relatively few complications in this population of oncologic patients. Prospective studies with protocoled surveys assessing patients before and after surgery are needed to further examine these findings. The issue of costs must also be addressed.

FM 100

Approach to tumors of the acetabulum and proximal femur by surgical hip dislocation

Dr. Pascal Schai, Luzerner Kantonsspital Wolhusen, Wolhusen/CH; Dr. Richard Herzog, Luzerner Kantonsspital Wolhusen, Wolhusen/CH; Prof. Dr. Ulrich G. Exner, Orthopädie Zentrum Zürich, Zürich/CH

Rationale: Surgical dislocation of the hip is used to treat femoro-acetabular impingement, and femoral head reconstruction (e.g. Perthes). Few cases have been reported using hip dislocation for the treatment of tumors (Günel U 2013; de Los Santos 2013; Li M 2012 and Jellicoe P 2009). We wish to add our experience with 4 cases.
Materials: The surgical technique of hip dislocation was used as described by Ganz et al. 2001. Patient 1: 9y old girl; Ewing sarcoma of the acetabulum. En bloc removal, reconstruction of the posterior wall by a muscle pedicled bone block from the iliac crest , f/u 8 yrs Patient 2: 24y old female patient; Osteochondroma anterio-cranial to lesser trochanter. Tangential resection, without recurrence at f/u 4 yrs Patient 3: 57y old male patient; Recurrent chondrosarcoma femoral neck. En bloc resection, reconstruction with autologous iliac bone graft and protective LCP, f/u 3 years Patient 4: 29y old male patient; Giant cell tumor acetabulum. Curetted and thermocoagulated intralesionally, f/u 6 months.
Results: All patients recovered uneventfully from the surgical hip dislocation approach and regained full hip function. In patients 1 to 3, pathologic examination showed uncontaminated margins; they are free of recurrence at 3 to 8 years follow-up time. The follow-up time for the giant cell tumor in patient 4 is too short for final evaluation.
Conclusion: Surgical hip dislocation can be a useful approach for the treatment of intraarticular hip tumors or those close to the hip joint and needing excellent visual control to avoid damaging articular structures.

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FM 101

Megaprosthesis implantation after wide resection of the proximal tibia in osteosarcoma patient: 29 years of follow-up

Dr. Marco Germann, Universitätsklinik Balgrist, Zürich/CH; Miklos Cserhati/CH; Dr. Stephan Keller, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Osteosarcoma is the most frequent malignant primary bone tumor with its highest incidence in adolescents and young adults. In a multidisciplinary approach, surgery has become the mainstay. Although it is often mutilating, preservation and reconstruction of the limb may be achieved with a tumor mega prostheses and, in selected cases, allograft (combined with autograft) reconstruction. Amputation and rotationplasty are alternatives. Tumor mega prosthesis is associated with complications such as loosening and infections which frequently affect the long term survival. Because multiagent treatment approach has improved survival more patient become long-term survivor, thereby presenting particular challenges for the construct.
Case report: We present the case of a male patient in whom osteosarcoma of the left proximal tibia was diagnosed at the age of 23 years. He was treated with chemotherapy and wide resection of the proximal tibia. For reconstruction a prototype custom-made tumor prosthesis was implanted. Follow- up was unremarkable. At the age of 46 he started to have minor load- dependent pain in his left knee, no night pain. He also noticed a decreased stability for the last 2 years. Within a few months the discomfort increased that he needed to take painkillers regularly and he even had to walk with crutches occasionally. Joint aspiration showed a yellowish clear fluid, less than 50 cells/µl and no microorganisms. In a CT scan there were no signs of loosening of the prosthesis but breakage and abrasion of the polyethylene inlay. Due to the substantial distress, surgical revision was needed. Replacement of the inlay was not possible, because such an inlay was not available anymore. Therefore all components of the prosthesis had to be replaced using a new mega prosthesis. At revision the prosthesis was fixed and showed well fixed stems without any signs of loosening, whereas the hinge design was worn out. However, because of the well fixed implant and the lack of modular component exchange, we had to sacrifice bone stock.
Conclusion: This is to our knowledge the longest reported survival of a tumor endoprosthesis after resection of an osteosarcoma. Because of increased survival of patients and despite long-term survival, remaining bone stock becomes a real issure regarding the remaining life- expectancy.

FM 102

Avoiding traction damage to the brachial plexus – a reconstruction technique after Tikhoff-Linberg procedure

David Bauer/CH; Dr. Stephan Keller, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: The Tikhoff-Linberg procedure was originally described more than 80 years ago as a limb-sparing surgical option for malignancies involving the shoulder girdle. Damage to brachial plexus caused by traction of the hanging arm is a well described issue resulting in referred pain and paresis. We present the results of a weight distributing reconstruction technique after resection of the scapula and the proximal humerus following the diagnosis of a partly pleomorphic- spindle cell sarcoma of the right shoulder in a 72 year old male.
Methods: Preoperative work-up showed an MDM2 negative, partly pleomorphic-spindle cell sarcoma of the right scapular involving the supraspinatus muscle, subscapular muscle and infiltration of the suprascapular nerve and adjacent vessels. En-bloc resection of the scapula and the proximal humerus as previously described by Tikhoff and Linberg was performed. A 6 mm Mersilene® band connecting the

remaining clavicle and the inferior angle of the scapula was passed underneath two ribs forming a hanging-bridge mechanism. A Trevira® textile tube covering the osteotomized humerus was attached to this construct supporting the humerus in a hanging position.
Results: Histopathologic examination of the resected specimen confirmed the diagnosis of a pleomorphic-spindle cell sarcoma. Soft tissue- as well as osseous resection margins were found to be free of malignant cells, thus confirming a R0 resection of the tumor. At a six month follow-up a CT scan revealed two suspicious lesions in left and right lungs. A thoracoscopic resection of the smaller left lesion and an open resection of the right larger lesion were performed.
Histopathologic findings were consistent with metastatic spread of the primary tumor. At a 1-year follow-up CT-scan of the chest and MRI scan of the right shoulder showed no signs of local recurrence or metastasis. Physical examination revealed restricted but pain free shoulder motion. The patient reported no referred pain resting the arm in a hanging position.
Conclusion: The Tikhof-Linberg procedure is a profoundly mutilating intervention leaving the surgeon with little options for reconstruction. We present a reconstruction technique resembling a hanging-bridge mechanism to avoid traction damage to the brachial plexus.

FM 103

Muscle degeneration associated with rotator cuff tendon release and/or denervation in sheep

Dr. Karl Wieser, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Dominik Meyer, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Martin Flück, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Brigitte von Rechenberg, Vetsuisse Faculty, University of Zurich/CH; Mario Benn, Vetsuisse Fakultät, Universität Zürich/CH; Prof. Dr. med. Christian Gerber, Universitätsklinik Balgrist, Zürich/CH

Introduction: Chronic tendon tears and peripheral nerve injuries can be associated with atrophy, fatty infiltration and interstitial fibrosis of the corresponding muscle. For the rotator cuff it has been postulated that myotendinous retraction of the posterosuperior rotator cuff, could also induce a traction injury to the suprascapular nerve, which could contribute to muscle degeneration after tendon tear. It was therefore the purpose of this study to investigate the structural and biological muscle degeneration patterns caused by tendon release and/or muscle denervation in a sheep rotator cuff tear model.
Methods: Infraspinatus muscle biopsies of 18 sheep were taken before and 16 weeks after either tendon release (T) (n = 6) alone, neurectomy of the suprascapular nerve (N) (n = 6), or combined teno- and neurectomy (T&N) (n = 6). Histologically muscle fiber composition and interstitial fat were assessed. MRI and CT imaging of the infraspinatus muscle were performed immediately and 6 and 16 weeks after surgery for investigation of tendon retraction, muscle volume, tissue density, and fat fraction (MRI DIXON).
Results: At 16 weeks infraspinatus atrophy was significantly greater after neurectomy (muscle volume decrease to 47 ± 7% of baseline value; p = 0.001) and combined teno- and neurectomy (decrease to 48 ± 13%; p = 0.005) than after tenotomy alone (decrease to 78 ± 11%). The greater atrophy of the infraspinatus after neurectomy was accompanied by marked edema of the muscle at 6 and 16 weeks. The pennation angles were smaller and the muscle fibers longer compared to tenotomy alone. The intramuscular fat was not significantly different between the groups after 16 weeks (T: 50 ± 9%; T&N: 46 ± 10%; N: 40 ± 11%, p = 0.12–0.83). The amount of musculotendinous retraction was not significantly affected by additional neurectomy (T: 5.8 ± 1 cm; T&N: 6.4 ± 0.4 cm; p = 0.26). Conversely stiffness was increased in sheep with additional neurectomy (T&N) at 16 weeks.
Conclusion: Muscle changes after denervation are different from changes seen after tendon release alone. These findings provide baseline information for future investigations and for clinical differentiation between muscle degeneration caused by denervation or rotator cuff tendon tear.

FM 104

PARP1 knock out leads to decreased atrophy and fatty infiltration in a chronic rotator cuff tear mouse model

Dr. Michael Künzler, Inselspital Bern, Universität Bern, Bern/CH; Dr. Katja Nuss, Vetsuisse Faculty, University of Zurich, Zürich/CH; Dr. Agnieszka Karol, Vetsuisse Fakultät, Universität Zürich/CH; Dr. Michael Schär, Orthopädie und Traumatologie, Universität Bern, Bern/CH; Prof. Dr. Michael Hottiger, Universität Zürich, Vetsuisse Fakultäth/CH; Prof. Dr. Brigitte von Rechenberg, Vetsuisse Faculty, University of Zurich/CH; PD Dr. Matthias Zumstein, Inselspital Bern, Bern/CH

Introduction: Both muscular atrophy and fatty infiltration are still irreversible in chronic rotator cuff tears (RCT) and repairs. Poly-[ADP-ribose]-polymerase 1 (PARP1), a nuclear factor for DNA damage repair has shown to be one key factor in the up-regulation of early muscle inflammation, muscle atrophy and fat deposition. We therefore hypothesized that the absence of PARP1 would lead to less early inflammation, muscle atrophy and fatty infiltration subsequent to combined tenotomy and neurotomy in a PARP1 knock out mouse model.
Methods: PARP1 knock-out (KO group) and standard wild type C57BL/6 (WT group) mice were randomly allocated into three different time points (1, 6 and 12 weeks, total n = 120). In all mice the supraspinatus (SSP) and infraspinatus (ISP) tendon of the left shoulder were detached and the SSP muscle was denervated according to a recently established model. Macroscopic muscle weight analysis, retraction which was documented using macroscopic suture, histology, immunohistochemistry, gene expression analysis using real time qPCR (RTqPCR), were used to assess the differences of early inflammation, atrophy, and fatty infiltration between knock out and wild type mice in the supraspinatus muscle.
Results: In both groups the muscles retracted visually; however, the WT muscles retracted more than KO muscles. Tenotomy and denervation resulted in a significant loss of muscle mass in both groups compared to the contralateral side (KO group 62 ± 11% and WT group 52 ± 11%, p = 0.04) 6 weeks after surgery. 12 weeks postoperatively, the muscular mass increased significantly to almost normal in KO group compared to the WT group (14 ± 6% and 42 ± 7% lower muscle mass respectively; p <0.0001). Gene expression levels of inflammatory and muscular atrophy genes 1 week, as well as adipogenic genes 12 weeks after surgery revealed significantly decreased gene expression in KO group compared to WT group.
Discussion: Our preliminary results show for the first time that PARP1 knock-out leads to decreased early inflammation after tenotomy of the rotator cuff muscle. Although PARP1 knock-out and wild type mice developed severe atrophy 6 weeks after surgery, the muscles of the PARP1 knock out mice regenerated to almost normal size after 12 weeks. These findings taken together with a lower expression of adipogenic genes, leads to the conclusion that PARP1 has a negative influence on the restoration of muscular integrity after RCT.

FM 105

An accurate quantitative method to measure rotator cuff muscle degeneration in TSA planning

Dr Alexandre Terrier, EPFL, Lausanne/CH; Antoine Dewarrat/CH; Dr Fabio Becce, Centre hospitalier universitaire de Lausanne, Lausanne/CH; Prof. Dr. Alain Farron, CHUV, Lausanne/CH

Introduction: Accurate assessment of rotator cuff muscles is essential when planning anatomical total shoulder arthroplasty (TSA). Even when rotator cuff tendons are functional, different types of muscle degeneration can be observed and weaken muscle strength. Rotator cuff degeneration is usually evaluated qualitatively using the 5-point Goutallier grading system. The objective of this study was to propose a semi-automatic quantitative measurement method, based on CT scans used for preoperative TSA planning.
Methods: We selected 107 preoperative CT scans performed before TSA of primary osteoarthritic glenohumeral joints without rotator cuff tears. From the CT dataset, the measurement plane was perpendicular to the scapular axis and coincident with the spinoglenoid notch. The scapular axis and spinoglenoid notch were calculated in 3D, using specific bony landmarks [1, 2]. A sagittal oblique CT slice was reconstructed on that measurement plane, showing the typical Y-shape of the scapular bone. Supraspinatus (SS), subscapularis (SC), infraspinatus (IS) and teres minor (TM) muscles were separately analyzed, by manually drawing their contours. Areas of muscle atrophy, fatty infiltration, and secondary osteochondromas were automatically generated from Hounsfield unit threshold values. The 4 items were combined in a degeneration ratio (D) that represented the fraction of

muscle tissue relative to the normal cross-sectional area. The reliability of the measurement was evaluated with intraclass correlation coefficients (ICC).
Results: Average SS, SC, IS and TM degeneration was 0.37, 0.16, 0.11, and 0.13, respectively. SS degeneration greater than 0.5 was observed in more than 20% of the cases. Atrophy was the main contributor of degeneration. In average, fatty infiltration represented less than 2% of the degeneration. Secondary osteochondromas were observed in 24% of the cases, but only in SS and SC, and were responsible for less than 1% of degeneration. ICCs were all higher than 0.93.
Conclusion: The proposed method provided a semi-automatic, accurate and quantitative alternative to the conventional subjective 5-point Goutallier grading system routinely used to characterize the degeneration of rotator cuff muscles. This method could be fully automatized within a preoperative planning software to help the surgeon in accurately and quickly be aware of the rotator cuff function.

References [1] Terrier et al. BBJ. 2014;96-B(4):513–18.
[2] Terrier et al. JSES. 2015;24(2):295–301.

FM 106

Supraspinatus tendon load during abduction is dependent on the size of the critical shoulder angle. A 3-dimensional finite element model

Dr. Arnd Viehöfer, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Jess Gerrit Snedeker, Balgrist University Hospital, Zurich/CH; Prof. Dr. med. Christian Gerber, Universitätsklinik Balgrist, Zürich/CH

Introduction: Shoulders with rotator cuff tears (RCT) tears are associated with significantly larger critical shoulder angles (CSA) (RCT CSA = 38.2°) compared to shoulders of disease-free patients (CSA = 32.9°). We hypothesized that larger CSAs increase the ratio of joint shear to joint compression forces, requiring substantially increased compensatory supraspinatus loads.
Methods: An earlier described (Favre 2010) 3D finite element (FE) model was used. The model consists of the scapula and the humerus as solid surfaces, 27 beam elements represented segments of all muscles crossing the glenohumeral joint and the supraspinatus muscle additionally as a volumetric deformable body. The acromion of the scapula was modified to create a model with the CSA of 38.2° found in patients with RCT and a model with the normal CSA (32.9°). To simulate a static abduction in the scapular plane the humerus was elevated to 21 abduction angles. In a first step for each abduction angle the moment arms for each muscle segment were gained through a wrapping process. In a second step the muscle forces were calculated to compensate the moment caused by the weight of a simulated arm of 35N minimizing muscle stress. The joint reaction force components and were calculated. If the shear force exceeded 55% of the compressive force additional force was applied to the rotator cuff muscles to provide stability.
Results: The model showed an increase in the joint shear to joint compressive forces for the model with the RCT CSA (32.9°) compared to the normal CSA (38,2°) for abduction angles between 40 and 90°. The maximum difference was found at an abduction angle of 55° where the shear forces composed 82% of the compressive forces for the RCT CSA versus 53% for the normal CSA. To achieve stability (defined as shear forces beeing less than 55% of the compressive joint forces) large additional rotator cuff force was required in the model with the RCT CSA, with resultant muscle forces (880N) exceeding physiological values for an abduction angle of 45°.
Conclusion: Our results document that a higher CSA leads to instability of the glenohumeral joint. To restore stability during abduction a higher force of the supraspinatus is required. This lends strong support to the concept that a high CSA can induce SSP overload of the slightly abducted arm.

FM 107

The effect of supraspinatus tears and repairs on glenohumeral translations in passive pitching motion

PD Dr. Andreas Marc Mueller/CH; PD Dr. Claudio Rosso, University Hospital Basel/CH; PD Dr. Ara Nazarian, Center of Advanced Orthopedic Studies, Beth Israel Deaconess Medical Center, Boston, MA/CH; Prof. Ugo Della Croce, University of Sassari, Sassari/CH; PD Dr. Arun J Ramappa, Beth Israel Deaconess Medical Center, Boston, MA/US;PD Dr. Joseph deAngelis, Beth Israel Deaconess Medical Center/US

Introduction: Supraspinatus (SSP) tears are common in pitchers. However, their effect on glenohumeral (GH) mechanics is incompletely understood. This study sought to describe the effect of supraspinatus tears and repairs on GH kinematics during an abbreviated throwing motion using the intact shoulder girdle. We hypothesized that SSP tears would lead to an increase of GH translation in the coronal plane while SSP repairs would restore GH kinematics.
Methods: Six shoulders from three fresh frozen cadavers were tested in a novel seven degree of freedom robotic testing system. Torsos were mounted and the wrist was pinned to an actuator mounted on a upper frame. After removal of the deltoid, the shoulders were studied during an abbreviated throwing motion (ATM) from maximum external rotation to the mid-coronal plane to establish a baseline (BL). The ATM was repeated after creation of a 1cm SSP tear (ST1), a 3 cm SSP tear (ST2) and repair using a transosseus equivalent (TOE) technique. The GH kinematics were measured using retroflective bone markers and high-speed infrared cameras to calculate the center of rotation of the GH joint (CORGH) instantaneously.
Results: One centimeter and 3 cm SSP tears did not result in a significant alteration of GH translation. The TOE repair shifted the CORGH posteriorly, as evidenced by a significant decrease in the overall GH translation in all three planes ($P = 0.003$, 0.019 and 0.026 for xy, yz and xz planes respectively).
Conclusion: In contrast to a TOE repair of the supraspinatus tendon, isolated supraspinatus tears did not perturb GH kinematics in this cadaveric model of the throwing shoulder. In throwing athletes, treatment of rotator cuff tears should be addressed with caution in order to avoid an unintended alteration in GH kinematics due to a over tightening of the tendon.

FM 108

High differences in subacromial space height and gleno-humeral compression according to shoulder muscle exercise type

Dr Nicolas Holzer, Hôpitaux Universitaires de Genève, Genève/CH; Dr Sylvain Chagué, Artanim Foundation/CH; PD Dr Alexandre Lädermann, Hôpital de La Tour, Genève/CH; Dr Jean-Luc Ziltener/CH; Dr Caecilia Charbonnier, Artanim Foundation/CH; Prof. Dr Pierre J. Hoffmeyer, Hôpitaux Universitaires de Genève/CH

Introduction: Numerous types of exercises have been described targeting specific shoulder muscles. Determination of tendons and joint compression is required for recommendation of the types of exercises to use in presence of pathologies of the rotator cuff or gleno-humeral osteoarthritis. Our objective was to determine subacromial space narrowing and articular as well as labrum compression forces in most commonly trained shoulder muscles and exercise techniques.
Methods: One healthy male volunteer underwent magnetic resonance arthrography and motion capture of the shoulder. Motion data from the volunteer were recorded during 31 rehabilitation exercises targeting 11 most frequently trained shoulder muscles or muscle groups and using up to four different techniques when available: cable bar machine, dumbbell, body weight and TheraBandTM. Glenohumeral kinematics was computed and applied to the subject's shoulder 3D models. All measures were acquired on the entire range of motion during motion simulation. Subacromial space height was assessed by measuring the minimum distance between the inferior acromial surface and the humeral head surface. Compression between humeral, glenoid cartilages and labrum surfaces were computed as maximal surface-to-surface distance between each structure.
Results: Minimal subacromial height varied up to 14.1-fold for targeted muscles exercises according to the training technique used. Cartilages compression varied up to 6.6-fold and labral compression up to 5.7-fold. Contacts were all located between the antero- and postero-superior sectors of the glenoid. Least favorable target muscles training with respect to cartilages and labrum compression were biceps brachii, pectoralis major and supraspinatus. Overhead strength training resulted in significant decrease ($p = 0.001$) of subacromial space height compared to non-overhead strengthening exercises, as expected.
Conclusion: Important variations in subacromial space height, as well as cartilages and labrum compression were observed according to the type of strengthening exercise. Results allow for design of pathology specific shoulder strengthening protocols.

FM 109

PRP augmentation is not cost effective for arthroscopic repair of small and medium sized rotator cuff tears

Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; PD Dr. Patrick Sadoghi, Medizinische Universität Graz/AT; Matthew Palmer, Harvard Business School/US; PD Dr. Claudio Rosso, University Hospital Basel/CH; PD Dr. Andreas M. Müller, Universitätsspital Basel, Basel/CH; Dr. Gregor Szöllösy, University Hospital Basel/CH; Prof. Dr. Dr. med. Victor Valderrabano, Universitätsspital Basel, Basel/CH

Introduction: Prior research has shown that PRP augmentation reduces retear rates after arthroscopic repair of small and medium sized rotator cuff tears. The objective of this study was to assess the cost-effectiveness of such biological augmentation.
Methods: Published evidence from controlled, human trials of rotator cuff repair augmented with platelet concentrates was systematically gathered, as well as data on revision rates and costs to calculate cost-effectiveness and the finacial headroom for PRP treatment. Sensitivity analyses were done including different rates of revision, different prices of PRP and different retear rates.
Results: From a meta-analysis of the current best evidence the number-needed to treat to prevent one retear with the use of PRP is 14 treated patients. Revision rates for small and medium retears have been reported in the range of 4% to 10%. The cost of rotator cuff repair was estimated between $7,572 and $9,119 for single row repair using one or two anchors respectively. The cost of PRP treatment ranges from $250 to $650. As such, treatment with PRP results in a negative cost-effectiveness ratio until (potential) revision rates for retears reach 40%. The financial headroom for PRP in the range of published revision rates ranged from $22 to $43 per treatment, which is somewhat lower then current market costs.
Conclusions: PRP does produce a statistically significant reduction of retears after rotator cuff repair of small and medium tears. However, because of the low revision rates of such retears, the financial headroom for PRP treatment is very lower. Thus, despite the benefical biological effect, PRP treatment is not cost-effective with current market prices.

FM 110

Critical shoulder angle affects shoulder muscle forces, joint and cartilage load during simulated abduction

Christoph Engelhardt, Laboratory of Biomechanical Orthopedics, Lausanne/CH; Prof. Dr. Alain Farron, CHUV, Lausanne/CH; Dr Fabio Becce, Centre hospitalier universitaire de Lausanne, Lausanne/CH; Dr Alexandre Terrier, EPFL, Lausanne/CH

Introduction: Radiological clinical studies have reported a link between the critical shoulder angle (CSA) and glenohumeral osteoarthritis (Moor 2012). In the present study, we evaluated the potential mechanical causes for this observation with a patient-specific musculoskeletal model.
Methods: A numerical musculoskeletal shoulder model was implemented from in vivo MRI images of a 28 years-old male volunteer showing no sign of shoulder pathology. The model included the 4 joints and 16 muscles of the shoulder complex. Muscle and joint forces were calculated during abduction in the scapular plane, from rest up to 120 degrees of elevation. A finite element model of the glenohumeral joint was developed using the same in vivo MRI images. The joint force calculated by the musculoskeletal model was applied. Glenoid and humeral cartilage were modeled as hyperelastic materials. The humeral head was free to translate frictionless within the glenoid cavity. The CSA is defined as the angle between a first line connecting the superior and inferior edge of the glenoid, and a second line connecting the inferior edge of the glenoid with the lateral border of the acromion. We compared 2 typical CSA: normal (33°) and small (28°). In the numerical model the CSA was changed by shifting the medio-lateral position of the acromion (middle deltoid origin).
Results and discussion: Compared to the normal CSA, a small CSA decreased rotator cuff muscle force –20%, and increased middle deltoid force +11%, joint force +7%, and contact pressure +5%. These effects were more important below 60° of elevation than above. The MRI images provided anatomic data with a normal CSA, and the numerical model was able to predict tendencies for larger and smaller CSA. As a next step, simulating more complex movements of activities of daily living should improve the understanding of the mechanical effect of CSA on glenohumeral osteoarthritis.
Conclusion: This numerical study supports the clinical hypothesis that small CSA promotes the development of osteoarthritis.

Reference: Moor et al, Bone Joint 2013;7:935–41.

FM 111

The "Norris-PSI": A new technique using 3D planning and patient specific instruments for reconstruction of large glenoid defects and implantation of a reverse shoulder arthroplasty

PD Dr. Karim Eid, Orthopädiezentrum Kantonsspitäler Aarau/Baden, Aarau/CH; Cyril Inauen, Badem/CH; Dr. Mathias Häfeli, Orthopädiezentrum Kantonsspitäler Aarau/Baden, Baden/CH

Introduction: Large glenoid defects after multiple operations impose a difficult surgical challenge. The use of a tricortical bone graft from the iliac crest has been advocated by Norris et al. In this procedure the base plate is directly implanted onto the iliac crest. An appropriate bone block together with the glenoid component is then transferred to the remaining native glenoid or scapula. Optimal glenoid component positioning is crucial to avoid early loosening and impaired shoulder function. However, in the presence of large glenoid defects, base plate implantation in correct version, inclination, and lateralization is difficult. We describe a new technique using 3D-preoperative planning and patient-specific instrumentation (PSI) to assist in reconstruction of a large glenoid defect and implantation of a reverse total shoulder prosthesis.
Methods: A 61 year old patient showed a large glenoid defect after multiple surgical interventions, ultimately after implant removal due to an infection caused by propionibacterium acnes. Postoperatively, a 3D-CT of the scapula and of the ipsilateral pelvis was performed. The 3D-model of the glenoid defect was then "transposed" to the 3D-model of the iliac crest and implantation of the baseplate was planned within the pelvic bone. Patient specific instruments for the glenoid and resection guides for the pelvic bone block were then produced. After 6 weeks of antibiotics, the surgical procedure was performed. The guide wire for the drill was placed into the iliac crest already in correct inclination and version with respect to the later positioning in the shoulder. After drilling, the baseplate with a 25 mm long post was then fixed onto the iliac crest. Resection of the bone block was guided by the patient specific resection guides. The baseplate and bone-block were transferred to the debrided native glenoid. Press fit was immediately achieved and fixation screws were placed with the PSI-drill guides. Further procedure included implantation of a revision stem.
Results: Postoperatively the patient was pain free, there were no signs of persistent infection and functional recovery was evident. Radiological assessment showed accurate implantation of the glenoid baseplate within 5° of the preoperatively planed position for inclination and version.
Conclusion: Combined preoperative 3D-planning and application of PSI allow precise bony reconstruction and implantation of the glenoid baseplate even in difficult revision cases.

FM 112

Glenoid Loosening and Migration in Reverse Shoulder Arthroplasty

PD Dr Alexandre Lädermann, Hôpital de La Tour, Genève/CH; Dr Adrien Schwitzguébel, FORE (fondation de La Tour pour la recherche et l'enseignement), Grand-Lancy/CH; Dr Gilles Walch/FR; Prof. Dr. med. Christian Gerber, Universitätsklinik Balgrist, Zürich/CH

Introduction: Mechanical or chemical glenoid loosening and migration are rare complications of reverse shoulder arthroplasty (RSA). The purpose of this study was to analyze the different types of glenoid loosening, the risk factors associated to this condition, and the clinical outcome in relation to different surgical or non-surgical options that have been chosen.
Methods: This retrospective study included loosening and migration of glenoid component in RSA in 7 centers between 1991 and 2014. We excluded patients with follow-up of less than 6 months, or septic loosening. The outcome of interest was the treatment that was proposed to the patient, either surgical or conservative. Furthermore, we analyzed the type and the delay of loosening and migration, the functional Constant score, the degree of active elevation and subjective results.
Results: We collected 71 cases in 68 patients. Three patients were excluded from the study because of a septic loosening. Thus, there were 65 patients (67 prostheses) for the final analysis at a mean follow-up of 37 (range: 6–150) months. Fifty-one patients were women and 16 were men, their mean age being 74 years (range: 47–87) when the RSA was implanted. Different types of glenoid loosening or migration were observed. 45 underwent a revision (67%) and 22 (33%) have been treated conservatively. Among the former group, 2 (4%) had removal of the implant, 25 (56%) a prosthetic revision and 18 (40%) a conversion in hemi-arthroplasty. Mean glenoid loosening and migration

were observed at 17 (range: 0–150) and 15 (range: 0–93) months after the initial implantation, respectively. At last follow-up, the overall results were poor. In whole sample, the mean Constant score increased by 21 points (from 23 to 43), the mean pain score by 4 points (from 6/15 to 10/15) and the mean active anterior elevation from 66° when loosed or migrated to 94° after revision. Subjectively, 14 patients (26%) were satisfied or very satisfied from their condition, while 39 (74%) were disappointed or dissatisfied.
Conclusion: The first finding concerning this series is the low number of cases that were reported. Few patients had failure of the glenoid component of a RSA in 7 centers specializing in shoulder surgery, which extensively use this implant. This study validates the hypothesis that the implanting of a new glenoid implant is feasible, regardless of whether it's re-implanting is performed with or without bone grafting, in one or two stages.

FM 113

Underestimation of complications, the reason for multiple revisions after shoulder arthroplasty

Dr Nicolas Holzer, Hôpitaux Universitaires de Genève, Genève/CH; Dr Toby Baring/FR; Dr Charles Bessières/FR; Dr Patrick Gendre/FR; Dr Thomas D'Ollonne/CH; Dr Jean-François Gonzales/FR; Prof. Pascal Boileau/FR

Background: Repetition of the same complication or apparition of a new one after revision shoulder arthroplasty may require revising a shoulder implant more then once. Reasons for multiple revision procedures and impact on outcomes of final implants have not been clearly established.
Purpose: To identify reasons leading to multiple revision shoulder arthroplasty and to compare outcomes with patients revised only once.
Method: Retrospective, single center, consecutive cohort study of revision shoulder arthroplasty patients over 20 years; one-year minimal follow-up. Indications for revision and postoperative complications were recorded. Final outcomes (Constant score, Constant score pain subset and self rated satisfaction) were compared between both groups.
Results: 184 revision shoulder arthroplasty patients were included. Multiple revisions were undertaken in 21 patients for a total of 53 procedures; 163 patients had a single revision. Patients were re-operated because of persistent pain and shoulder pseudoparalysis. For hemiarthroplasty (HA, n = 3), main complication leading to multiple revisions was glenoid erosion. For total shoulder arthroplasty (TSA, n = 6), it was glenoid loosening due to subscapularis insufficiency. For reverse prostheses (RSA, n = 23), it was humeral loosening and instability due to humeral shortening and excessive medialization. Bone grafting the glenoid and the humerus was often needed. Final implant was a RSA in 18 cases and a TSA in 3. Mean adjusted final Constant score was 29% for multiple revision procedures vs. 73% for single ones (p <0.001). Rate of unsatisfied patients were 29% and 13.8% respectively (p <0.001). Constant score pain subset was similar in both groups.
Conclusions: (1) Causes for multiple revision procedures after failed shoulder arthroplasty depends on the type of the previous implant; in HA/TSA it is underestimation of glenoid damage and subscapularis rupture and in RSA, underestimation of humeral shortening and excessive medialization; (2) RSA is the most frequently retained implant, solving both bony and soft tissue insufficiencies; (3) objective and subjective results are significantly lower after multiple revision surgeries as compared to single ones.

FM 114

A three-dimensional comparative study on the alignment of the non-pathologic and osteoarthrotic glenohumeral joint

Dr. Matthijs Jacxsens, Universitätsspital Basel, Basel/CH; PD Dr. Andreas M. Müller, Universitätsspital Basel, Basel/CH; Dr. Alexander Van Tongel, Ghent University Hospital/BE; Prof. Dr. Lieven De Wilde, Ghent University Hospital/BE

Introduction: The purpose of this study was to quantify and compare the three-dimensional relationship of the glenohumeral joint in non-pathologic shoulders and in shoulders with primary osteoarthritis according to the glenoid morphology.
Methods: CT-scans of 151 non-pathologic shoulders and 112 shoulders with primary glenohumeral arthritis were analysed. First, the subluxation index was measured and the shoulders were classified as centered (Type A) or posterior subluxated (Type B) according to the Walch classification of glenoid morphology. Next, all shoulders were 3D reconstructed and a Cartesian coordinate system was defined with the midpoint of the native glenoid circle as the origin. Also the center of the humeral head (CR) was calculated In order to determine the glenohumeral relationship, the orientation of CR was measured in the Cartesian coordinate system by calculating its projection to the X- and Y-axis. The inter- and intrarater reliability was measured.
Results: The inter- and intrarater reliability was for all measurements good to excellent. According to the subluxation in 2D 55 shoulders were classified as type A and 57 as type B. In 3D type B (116.55°; SD, 10.47°) were significant (p <0.001) more posterior subluxated then type A (99.37°; SD, 8.18°), and normal population (95.89°; SD, 3.95°) and type A was also significant more posterior subluxated than the normal population.
Conclusion: Both Type A and Type B omarthrosis are showing significant posterior subluxation of the humeral head compared to the normal population. Correction of the glenoid to a neutral version only, will lead to a persistent humeral head overhang with a higher risk of glenoid loosening as a consequence. Thus, not only correcting the glenoid version but also soft-tissue balancing through soft-tissue releases should play a substantial role in total shoulder arthroplasty in order to restore the alignment of the glenohumeral joint.

FM 115

Loosening rates of cemented, pegged glenoid components in total shoulder arthroplasty before and after change of type of cement and radius of glenoid curvature

Dr. Anita Hasler, Universitätsklinik Balgrist, Zürich/CH; Dr. Tobias Dietrich, Uniklinik Balgrist/CH; PD Dr. Mazda Farshad, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. med. Christian Gerber, Universitätsklinik Balgrist, Zürich/CH

Introduction: Glenoid loosening is the most frequent long-term complication of total shoulder arthroplasty. For improvement, interest has focused on the design of the glenoid component and the cementing technique. The purpose of this retrospective analysis of prospectively collected data was to compare loosening before and after changing as well type of cement as radius of glenoid curvature.
Methods: The radius of curvature of the bearing surface of the formerly used standard polyethylene implant was increased without any other geometric or material changes and the modified implant was used since 2002. In addition low-viscosity Allofix was replaced by Palacos LV+G cement. We compared the prevalence of radiographic lucency and clinical outcome before and after these modifications. The first group consisted of forty-seven shoulders. Their glenoid loosening rate was studied at a mean follow-up of 40 months and published in the peer reviewed literature. The second group consisted of thirty shoulders operated by the same surgeon using no other changes than the modified glenoid implant and the different cement. As for these of group I, the loosening rate of these glenoid components was assessed computer-tomographically at a mean follow-up of 64 months.
Results: The mean radial mismatch was increased from 2.1 in group I to 4.7 mm in group II. Radiographic loosening (defined as modified Molé scores ≥6) was present in 6/47 (14%, 40 months) of group I and in 1/30 (3%, 68 months) shoulders in group II. Lucencies around the glenoid pegs (modified Molé score ≥1 und <6,) were present in 36/47 and 3/30 respectively. (p >0.0001) Group II lucencies were associated with the extent of preoperative but not postoperative glenoid retroversion. There was no correlation between radiolucencies and postoperative humeral head subluxation.
Conclusion: Increase of gleno-humeral radial mismatch from 2.1 to 4.7 mm and exchange of allofix with palacos cement is associated and highly significant with decrease of radiographic lucencies around the glenoid pegs in the tested setting.

FM 116

Predicting factors of recovering active forward flexion after reverse shoulder arthroplasty

PD Dr Alexandre Lädermann, Hôpital de La Tour, Genève/CH

Background: Recently reverse shoulder arthroplasty (RSA) has gained increasing popularity because of a clinical perception of an improved functional outcome. However, some patients show poor active forward flexion (AFF) after surgery. It has already been demonstrated that it could be related to initial diagnosis, and pre- and intraoperative range of motion. The aim of this study was to determine if other predicting factors of AFF after RSA exist.
Methods: Between January 2011 to January 2012, all patients who had a primary RSA were considered potentially eligible for inclusion in this prospective study. Inclusion criteria included patients suffering

from cuff tear arthropathy, massive cuff tear and biconcave glenoid with static posterior instability. We excluded patients with (1) incomplete documentation, (2) follow-up of less than 2 years, (3) any diagnosis (fracture sequellae, revision surgery, locked dislocation, trans-deltoid approach, etc) that could negatively influence preoperative passive range of motion or postoperative function. All shoulders were divided into 2 groups regarding AFF after surgery and analyzed what were the predicting factors of recovering AFF. The following baseline characteristics were assessed: age, sex, dominant arm, patient activity, BMI, diagnosis, deltoid status, pain and Constant scores, subjective shoulder value and radiographic findings. Patients were reviewed at 6 weeks, and 3, 6, 12 and 24 months.
Results: During the study period, 127 RSA were performed. Twenty-three patients were excluded from the study because of preoperative diagnosis. No patients declined to participate, 1 patient died and 2 were excluded because they declined postoperative examination, leaving a cohort of 101 RSA in 101 patients for the final analysis. Poor postoperative AFF was significantly related at 6 weeks to poor postoperative deltoid strength (MRC grade) and at 1 year follow-up to surgery of non-dominant arm, preoperative poor AFF, preoperative activity, poor subjective shoulder value, and contralateral poor Constant score.
Conclusions: This study revealed that RSA of non-dominant side, preoperative poor AFF, poor subjective shoulder value and poor contralateral Constant score are risk factors of poor recovering AFF. For function to be improved, it may be important to educate how to elevate and manage pain during motion.

FM 117

Matched-pair analysis of stemless versus conventional anatomic total shoulder replacement

Dr. Michael C. Glanzmann, Schulthess Klinik, Zürich/CH; Dr. Christoph Kolling/CH; Dr. Matthias Flury, Schulthessklinik Zuerich, Zürich/CH; Dr. Hans-Kaspar Schwyzer/CH; PD Dr. Laurent Audigé, Schulthess Clinic, Zürich/CH

Introduction: Humeral resurfacing was introduced to improve reconstruction of the individual anatomy, avoid stem-related complications, and preserve bone stock. This matched-pair control study investigates the clinical results of patients undergoing stemless and conventional anatomic total shoulder arthroplasty (TSA).
Materials and Methods: This retrospective analysis included patients with primary or secondary shoulder osteoarthritis as well as humeral head necrosis undergoing anatomic TSA with either the PROMOS resurfacing or standard prosthesis. Patients were divided into three age groups (<60, 60–70, >70 years) and frequency-matched according to a 1:2 (stemless:conventional) ratio. Six-, 12- and 24-month postoperative follow-up examinations were scheduled as part of the protocol in our local routine shoulder arthroplasty register. Function and disability were assessed using the Constant, QuickDASH and SPADI questionnaires. A standardized radiographic examination in three views was performed preoperatively as well as at each follow-up. The effect of the implant type on functional scores was investigated using mixed models adjusted for age and baseline scores with all follow-up time points included.
Results: Forty-six stemless and 92 conventional TSA prostheses were implanted between November 2006 and September 2012 and matched for evaluation. The mean patient age at the time of surgery was 62.5 and 64.2 years in the stemless and conventional groups, respectively. The median operating time for the stemless group was 114 min (range: 46–189) and 133 min (range: 67–720) for the conventional group ($p < 0.001$). Both cohorts reported significant improvements in function and pain. There were no significant differences in any of the scores between the groups ($p > 0.05$). Patients with a stemless implant reported less reduction in pain at 6 and 12 months post-surgery with a Constant pain subscore for pain of 1.2 to 1.3 points less compared to that for the conventional group. At 24 months, the Constant subscore pain was almost identical in the two groups (12.4 vs. 13.1; $p = 0.207$). No stem-related complications occurred. All implants showed no signs of loosening at final follow-up.
Conclusion: Stemless and conventional TSA patients show similar functional outcome at the short-term postoperative follow-up of 24 months. Operating time was significantly reduced with the stemless technique.

FM 118

Development of a novel patient-reported outcome measure: The computer-adaptive 'Forgotten Joint Score – Shoulder'

Dr. Karlmeinrad Giesinger, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Johannes Giesinger/AT; Nicolas Kesterke/CH; Dr. David Hamilton/GB; Prof. Bernhard Holzner/AT; Prof. Dr. Bernhard Jost, Kantonsspital St. Gallen, St. Gallen/CH

Introduction: Patient-reported outcome (PRO) measures have become a cornerstone of outcome assessment after shoulder surgery. In contrast to traditional PRO questionnaires, computer-adaptive testing (CAT) allows for individually tailored sets of questions for each patient. Based on the answers, CAT adapts to the individual patient by dynamically increasing / decreasing item (question) difficulty. These key features increase measurement precision and reduce patient burden. Joint awareness is a novel PRO concept reflecting patients' ability to forget about the affected shoulder in activities of daily living. The objective of our study was to develop a computer-adaptive, patient-reported outcome measure for joint awareness.
Methods: Item content was generated on the basis of literature search and expert ratings following a standardised 10-step refinement procedure including final evaluation by an international expert board and feedback from shoulder patients in Switzerland and the UK ($n = 60$). An IRT model was developed to investigate dimensionality and to determine measurement characteristics (i.p. item difficulty and measurement precision) of each item. Data from 300 shoulder patients were included in the model. Convergent validity of the novel CAT measure was determined through comparison with the Shoulder Pain and Disability Index (SPADI) in 144 patients.
Results: Literature search identified 45 shoulder questionnaires covering 805 issues (activities) potentially relevant for the assessment of joint awareness. Stepwise item selection resulted in 97 items to be evaluated by the international expert board, which produced a final 70 item list for collecting patient feedback. The majority of the 60 patients indicated that the introductory text explaining the forgotten joint concept was easy to understand (79.3%) and that the items were clear (91.4%). 8 items with >20% missing responses were discarded. The remaining 62 items showed high unidimensionality in a confirmatory factor analysis. Convergent validity with the SPADI Pain ($r = 0.66$) and Function ($r = 0.82$) scales was high.
Conclusions: We have created a comprehensive item list covering ADLs relevant for shoulder patients assessing the forgotten joint concept. The FJS shoulder item list showed high unidimensionality suggesting good measurement precision and good convergent validity to the SPADI. This item list is the basis for computer-adaptive assessment of the forgotten joint concept in shoulder patients.

FM 119

Is Arthroscopic remplissage a tenodesis or capsulomyodesis? An anatomic study

PD Dr Alexandre Lädermann, Hôpital de La Tour, Genève/CH

Purpose: Arthroscopic remplissage of a Hill-Sachs lesion is classically described as a capsolutenodesis of the infraspinatus within the posterolateral humeral head. We hypothesized that, according to the location of the impaction fracture, the procedure actually corresponds to a capsulomyodesis including the teres minor muscle. The aim of this cadaveric study was to evaluate the anatomical relationship between the position of the anchors implanted in humeral heads and the exit point of the sutures relative to the posterior shoulder muscles.
Methods: A two-anchor arthroscopic remplissage was performed followed by open dissection of ten fresh-frozen human cadaveric shoulders. The exit point of sutures related to muscle-tendon unit as well as distance between the anchors and the rotator cuff were measured.
Results: The superior sutures were localized generally in the infraspinatus, near the musclotendinous junction. The inferior sutures passed through the teres minor muscle in seven of ten cases. The distance between the superior and inferior anchors and the posterolateral greater tuberosity were 14.4 mm (range, 10 to 18 mm) and 11.9 mm (range, 9 to 17 mm), respectively.
Conclusions: Arthroscopic remplissage is a capsulomyodesis of infraspinatus and teres minor rather than a capsulotenodesis of the infraspinatus as previously believed. Clinical evaluation of capsulodesis alone should be evaluated in the future.

FM 120

Long-term survival of the cemented Müller CDH stem – radiological results and risk factor analysis for aseptic loosening

Yves Salentiny, Lausen/CH; Dr. Lukas Zwicky, Kantonsspital Baselland, Liestal/CH; Prof. Dr. Peter Ochsner, Kantonsspital Baselland, Liestal/CH; Dr. Martin Clauss, Kantonsspital Baselland, Liestal/CH

Introduction: Total Hip Arthroplasty (THA) in patients with hypoplastic femora and/or a narrow intramedullary canal with or without developmental dysplasia of the hip (DDH) is a challenging procedure often needing specifically designed stems. Cemented Müller straight stems have shown excellent long-term results, data on the cemented Müller CDH stem (CDH) belonging to this implant series are missing. Aim of our study was to analyse long-term survival and radiological results of cemented Müller CDH stems and to analyse potential risk factors for aseptic loosening.
Methods: Between 01/1985 and 06/2005 86 patients (75 female; 9 double-sided) were operated with a CDH stem (Zimmer). Mean age at surgery was 64 (43–88) years. All patients had a prospective clinical and radiological follow-up according to our in-house register. During the study period three different stem materials (stainless steel (SS) 38, CoCr 31, TiAl 26) were implanted. A Kaplan-Meier (KM) analysis using aseptic loosening of the stem as endpoint was performed. Radiographs were analysed for progressive osteolysis. A multivariable Cox regression analysis was performed to identify potential risk factors for aseptic loosening. These included age (<60, 60–70, >70 years), sex, primary diagnosis, stem alignment (±3° defined as neutral) and implant material.
Results: The mean follow-up was 11 (range 1–25) years. 31 patients (33 stems) died during follow-up, 4 patients (5 stems) were lost to follow-up. 13 stems have been revised for aseptic loosening, 2 for septic loosening, 1 for recurrent dislocation and 1 for other reason. KM survival was 84 (CI 75–92)% at 15 years with marked differences for the different stem materials: SS 97 (CI 91–100)%, CoCr 84 (CI 70–99)%, TiAl 65 (CI 48–88)%. The mean radiological follow-up was 9.9 (0.3–25.1) years. Osteolysis were mainly seen in Gruen Zone 2 (17%) and 6 (20%). The Cox regression model showed only one independant risk factor for aseptic loosening with a hazard ratio (HR) of 9.3 (CI:1.1–76.9) for stems made out of TiAl as compared to SS stems ($p = 0.04$).
Conclusion: Long-term results of the CDH straight stem were comparable to other successful dysplasia stems and long-term data from other Müller type straight stems. As for the original Müller straight stems TiAl showed an increased risk for aseptic loosening.

FM 121

Are additional anteroposterior hip radiographs required for precise templating in total hip arthroplasty?

Dr. Marc Attinger, Inselspital Bern, Bern/CH; Kim Kuonen/CH; Viktor Petrov/CH;Andrea Michel/CH; Prof. Dr. med. Klaus-Arno Siebenrock, Inselspital, University of Bern, Bern/CH; PD Dr. Frank Michael Klenke, Inselspital, Bern University Hospital, Bern/CH

Introduction: Accurate restoration of the physiological biomechanics in total hip arthroplasty improves abductor strength and range of motion. Traditionally, preoperative templating has been performed on anteroposterior (AP) radiographs of the pelvis. More recently, AP radiographs of the hip have been recommended for an accurate restoration of the femoral offset (FO).
Aim: We therefore analyzed the FO obtained by AP radiographs of the pelvis and the AP radiographs of the hip. Additionally, we created a mathematical model to calculate the theoretical difference of the FO on AP radiographs of the pelvis and the hip. In 55 patients, both AP pelvis and AP hip radiographs were obtained as pre-operative radiographs for templating of unilateral.
Methods: total hip arthroplasty. Patients position and x-ray beam setting followed a standardised protocol to achieve reproducible projections. All images were calibrated with the KingMark® calibration system and the FO measurements were performed with the validated TraumaCAD software programme (Voyant Health, UK). Additionally, a mathematical hip model was created to calculate the theoretical difference of the FO between the AP pelvic and AP hip projection when all degrees of freedom are applied to the hip joint.
Results: The mean FO measured on AP pelvis radiographs was 37.0 ± 4.8 mm and 38.2 ± 6.7 mm on AP hip radiographs (mean difference 1.2 ± 1.6 mm, $p = 0.21$). We observed a linear relationship between the FO measured on hip ap and pelvis ap radiographs (($r2 = 0.97$). Externally rotated hips showed a significantly higher FO on hip AP radiographs (χ^2 Test, $p < 0.001$). The mathematical model demonstrated no influence on the true FO when the hip is flexed or extended, a negligible difference with abduction and adduction and a minimal influence when the hip ist internally and externally rotated (with 15° externally rotated hip, the calculated difference equals 1.6 mm).
Conclusion: The x-ray measurements and the calculation of the geometrical model demonstrated that the difference of the FO obtained with AP radiographs of the pelvis and the hip is negligible. Only in severely externally rotated hips on the templating radiographs, the true FO might be underestimated. Additional AP hip radiographs add to the patients' radiation exposure without improving the precision of pre-operative templating of total hip arthroplasty. Consequently, AP hip radiographs do not seem to be required for routine total hip replacement templating.

FM 122

Are geriatric patients good candidates for short stem total hip arthroplasty? A multicenter prospective study

Dr Georgios Gkagkalis, Hôpital de Zone de Nyon, Nyon/CH; Prof. Werner Eduard Siebert, Hôpital de Zone de Nyon, Nyon/CH; Dr Franziska Juch, Helios Park-Klinikum Leipzig, Leipzig/DE; DrNaeder Helmy, Bürgerspital Solothurn, Solothurn/CH; Prof. Dr Joachim Pfeil, St. Josefs-Hospital Wiesbaden, Wiesbaden/DE; Dr Dominique Bosson, Hôpital de Zone de Nyon/CH

Introduction: The increasing use of minimal invasive surgery (MIS) and muscle sparing approaches as well as the need for bone stock preservation have led to the developement of metaphyseal engaging short stems for cementless total hip arthroplasty (THA). Since this kind of surgery aims a constantly increasing target group of geriatric patients, an important question arises: is advanced age (>75 years old) a contraindication for the use of short stems in total hip arthroplasty?
Methods: Data was prospectively collected in five centers in Switzerland and Germany up to 24 months after surgery. Clinical and radiological postoperative data were assessed for both age groups in intervals of 6–12 weeks, 6,12 and 24 months.
Results: A total of 261 patients were included in the younger group (<60 yo) and 142 patients were included in the elderly group (>75 yo). Primary osteoarthritis was the most frequent diagnosis in both groups, followed by developmental dysplasia of the hip (DDH) in the younger and secondary osteoarthritis in the elderly. The direct anterior and anterolateral approaches were the most frequently used in both groups. The outcome was evaluated both clinically and radiologically. The Visual Analog Scale (VAS) was used to assess rest and load pain as well as patient overall satisfaction before and after surgery for the two groups. VAS load pain VAS rest pain, VAS satisfaction and the Harris Hip Score (HHS) were strikingly improved for both younger and older groups at 24 months of follow-up (FU). Radiological evaluation of the stem on plain x-rays at 24 months of FU showed (younger vs older group): Resorption of the calcar was present in 7.4 vs 8.7% of the patients. Radiolucent lines in the stem-bone interface were present in 2 cases in the younger group with no cases in the elderly. Stem subsidence in the early postoperative period (6–12 weeks) was 11.9% in the younger vs 9.6% in the elderly with a mean of 2.0 mm (range 1.0 to 7.0) and 2.7 mm (range 1.0 to 15.0) respectively. Stem migration observed at 6 and 12 months of FU were 2.7 vs 3.7% and 1.5 vs 1.1%. No further stem migration was observed at 24 months of FU.
Conclusion: According to our encouraging results, cementless metaphyseal engaging short stems seem to be a safe choice for total hip arthoplasty in the elderly. Nevertheless, a longer follow up and larger prospective studies are necessary in order to further support this hypothesis.

FM 123

Femoroacetabular impingement existed ever since man invented the wheel – an anecdotal report of a 5000 year old swiss hip

Dr. Corinne Andrea Zurmühle, Inselspital, University of Bern, Bern/CH; Milella Marco, Universität Zürich, Zürich/CH; Dr. Simon Damian Steppacher, Inselspital, University of Bern, Bern/CH; Prof. Dr. med. Klaus-Arno Siebenrock, Inselspital, University of Bern, Bern/CH; Dr. Markus Simon Hanke, Inselspital Universitätsspital Bern, Bern/CH; Dr. Christoph Emanuel Albers, Inselspital Bern, Universität Bern, Bern/CH; Prof. Dr. Moritz Tannast, Inselspital, University of Bern, Bern/CH

Introduction: The femoroacetabular impingement (FAI) concept has been considered as a "new" pathomechanism after its first explicit description in 2003. Looking back into the history, sparse anecdotal

literature on this topic has been presented in the last century. Recent studies on osteological collections describe morphological features of cam-type deformities in a population from the end of the 19th century. There is no information if these pathomorphologies have existed long before this area. To show that (1) cam-type deformities existed before Christ, and (2) the location of the pathomorphology, the impingement zones and the joint damage found in historic specimens are similar to reports of contemporary hips in literature.
Methods: We analyzed a well-preserved femur and large fragments of the corresponding pelvis from an archaeological skeleton. This skeleton was found at Schweizersbild (Schaffhausen) – one of the oldest archaeological sites in Switzerland. Age of the specimen was detected with the C-14 method. The morphological analysis of the bones included a circumferential description of the alpha angle, epiphyseal morphology, offset, tilt angles and were compared to previously described reference values. Conventional radiography and high-resolution computed tomography were used to create a full three-dimensional virtual model of the entire pelvis and femur. The hip model was then animated virtually with validated software (HipMotion), and the impingement zones were correlated with the degenerative changes of the acetabulum and the femur.
Results: The age of the femur was 4980 years. A typical tongue-type cam deformity was found between 12 - and 3 o'clock with a maximum alpha angle of 78°. There was a typical epiphyseal extension as seen in cam-type deformities. The impingement zones were located at the area of femoral asphericity (anterosuperiorly) and between 3- and 8 o'clock on the acetabular side. These zones corresponded to the location of a present herniation pit at 3 o'clock and focal degenerative changes in the anterosuperior quadrant of the acetabulum.
Conclusion: This unique anecdotal report of an almost 5000 year-old Swiss hip proofs that cam-type deformities have existed ever since men invented the wheel (approximately 3500 B.C.) or hieroglyphs (approximately 3000 B.C.). The FAI concept is therefore not "new" but rather "lately described".

FM 124

Polyethylene wear of the cup in total hip replacement with Muller reinforcement ring

Dr. Aurimas Sirka/LT; Dr. Martin Clauss, Kantonsspital Baselland, Liestal/CH; PD Dr. Sarunas Tarasevicius/LT; Prof. Dr. Hans Wingstrand/SE; Dr. Justinas Stucinskas/LT; PD Dr. Thomas Ilchmann, LEONARDO – Ärzte für Orthopädie und Traumatologie, Münchenstein/CH

Introduction: Polyethylene wear contributes to the process of aseptic loosening and is seen as a one important reason for late failure after total hip replacement (THR). THR with Muller reinforcement ring (ARR) have showed favorable mid-term survival results, but we found no studies investigating polyethylene (PE) wear in combination with ARR.
Objectives: The aim of the study was to investigate PE wear in THR with ARR followed ≥10 years. Methods and materials: 321 consecutive primary arthroplasties with ARR were performed in 291 patients, between 1984 and 2002. For long-term wear and radiological analysis THR patients with ARR and cemented PE cup with at least 10 years radiological follow-up were included, leaving 133 THR implanted in 125 patients. For wear analysis linear and volumetric wear were measured. The analysis of age, gender, body mass index, head material, and head size in relation to volumetric wear was conducted using multiple regression analysis. Radiological assessment included evaluation of osteolysis, migration, and loosening.
Results: For wear and radiological analysis we included 44 males and 81 females with a mean age of 65 years (31–86, SD 9.9) and a mean follow-up of 13 years (10–23, SD 3.6). Out of 133 ARR, 9 were classified as loose and out of those 4 had osteolysis. Mean PE linear wear rate for all hips was 0.05 mm/year (SD 0.51), volumetric – 37 mm^3/year (SD 25.5). No correlation was found between gender, age, BMI with linear and volumetric wear rates. Greater volumetric wear rate was observed in the OA group (42 mm^3/year) as compared with DDH (26 mm^3/year). ($p = 0.0005$). The loose ARR had a mean wear rate of 0.07 mm/year (SD 0.04), volumetric – 52 mm^3/year (SD 32.3). Only larger head size diameter independently of head material affected increased volumetric wear rate ($p = 0.0005$).
Conclusions: We conclude that despite the thinner PE liner due to modularity, long-term wear rates were similar to cemented PE cups. Wear rate was affected only by head size and head material did not affect wear rates.

FM 125

14 year follow-up of the cemented Weber stem: survivorship of a composite beam (shape closed) stem

Dr. Pia Zurmühle, Landschlacht/CH; Dr. Kerstin Schneider, Zürich/CH; Dr. Karl Grob, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Johannes Erhardt/CH

Introduction: There are two main design philosophies in use for the primary cemented hip replacement. Composite beam or shape closed and taper slip or force closed. The composite beam cemented Weber stem has been used for more than 40 years, however little published data is available. Main outcome measure of this study is survivorship of the cemented Weber stem minimum 14 years after initial implantation for the primary diagnosis of osteoarthritis.
Methods: Between August 1999 and November 2000 we identified 200 consecutive stems implanted in 181 patients (mean age of 66 years at the time of surgery) with primary arthritis of the hip joint. 100 THA were implanted with normal polyethylene (PE), and 100 with highly cross-linked PE. A clinical and radiological follow-up was performed on 64 patients. 52 patients provided a systematic interview by phone or did return a written report. 70 patients died during the 14-year observation period due to age or for any medical reason not related to the index surgery. Information on the stem survival was retrieved from their general practitioners or their next of kin. A search of the general practitioners, relatives and Internet was unsuccessful in finding information about the remaining 14 patients.
Results: Stable stem were evident in 95% of our patient base after 14-year observation period. The overall revision rate for any reason was 4%. Stem survival rate was 95%. 154 patients had no revision surgery. 8 patients had a stem revision (3 due to aseptic stem loosening, 3 due to infection (2 low grad, 1 acute) and 2 after periprosthetic fracture). In all cases a 28mm head was used. There was no correlation between gender and revision rate or type of PE (normal vs. highly cross-linked) and revision rate. The mean age at time of revision was 68 years. 70 patients died during the follow up period. Of the patients available for clinical and radiological follow-up up at 14 years, the mean Harris Hip Score was 89 points.
Conclusion: Our data shows excellent long-term survival of the cemented Weber stem. Its composite beam design with a tapered geometry allows excellent long-term survivorship, independently of age, sex and the type of polyethylene used. Due to the high patient age by the time of the index procedure the mortality at 14 years is almost 25%.

FM 126

5 year follow up in using the Fitmore Stem©: general results and further development and clinical implications of distal femoral cortical hypertrophy

Dr. Caroline Thalmann, Kantonsspital Graubünden, Chur/CH; Dr. Heinz H. Bereiter, Kantonsspital Graubünden/CH; PD Dr. Karl Stoffel, Kantonsspital Baselland/CH

Introduction: For about 7 years we use the Fitmore© uncemented femoral stem for hip arthroplasties at our institution. In 2008 we started a prospective study including a series of 124 total hip arthroplasties with a Fitmore tapered femoral component. In 2011 we presented a one year follow up with promising results for hip arthroplasties with Fitmore© uncemented femoral stem. One year later we could reveal that a cortical hypertrophy – what was found in several patients – has no influence in the outcome so far. Now, 3 years later, we would like to present the result of the 5 year follow up of our series.
Methods: Between April 2008 and January 2010 a series of 124 total hip arthroplasties with a Fitmore tapered femoral component were performed at our institution. For the 5 year follow up, data of 89 hips were at disposal. Clinical evaluation included Oxford, SF12 and EQ-5D score, the incidence of thigh pain and BMI. Radiographic examination was – as in the 1 and 2 year follow up already – used to evaluate cortical hypertrophy, subsidence and resorption of the calcar.
Results: In the 5 year follow up, clinical scores show still promising results with high subjective and objective satisfaction of the patients. The progress of the cortical hypertrophy was again analysed in the last years. The trend observed in the 2 year follow up, where cortical hypertrophy decreased in 46% of all the hips with cortical hypertrophy continued also in the 5th year.
Conclusion: The 5 year follow up of hip arthroplasties using the fitmore stem© shows good or excellent results regarding clinical outcome. The overall satisfaction with the Fitmore© uncemented femoral stem is high. As in the 2 year follow up already shown, cortical hypertrophy, observed in nearly 50% of all patients after one year, has

still no influence in the clinical outcome and the trend of decreasing – as shown in the 2 year follow up – went on. The 5 year follow up of hip arthroplasties with a Fitmore tapered femoral component shows in general good or even excellent results. It is necessary to observe the further process to get information of the longterm outcome. Further follow ups will take place 7 and 10 years postoperatively.

FM 127

Association of patient satisfaction with the Oxford Hip Score and the Forgotten Joint Score after total hip arthroplasty

Dr. Martin Olach, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Johannes Giesinger/AT; Jan Meester, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Colin Howie/GB; Dr. David Hamilton/GB; Dr. Karlmeinrad Giesinger, Kantonsspital St. Gallen, St. Gallen/CH

Introduction: Patient satisfaction is one of the key parameters in elective surgery and is commonly assessed in clinical outcome studies. It has also gained interest as a single overarching outcome parameter. However, it is well known that patient satisfaction is influenced substantially by factors not directly related to total hip arthroplasty (THA), such as patient's mental status, hospital experience, cultural background and socioeconomic status.
Methods: We analysed prospectively collected registry data from patients undergoing THA at a large teaching hospital between January and June 2013 (New Royal Infirmary, Edinburgh, UK). Socio-demographic data, Oxford Hip Score (OHS, range 0–48), Forgotten Joint Score (FJS–12, range 0–100) and single questions to joint-related satisfaction and overall hospital experience were collected 6 and 12 months after surgery (5 point Likert response scale). Spearman correlations (r) and coefficients of determination (r2) were calculated.
Results: 6-month data was available from 253 patients, 19 patients were lost to follow-up at 12 months (7.5%). Mean age was 67.2y (SD11.5) with 59.8% female. OHS were 40.1 at 6 months and 40.9 at 12 months after surgery. FJS were 56.3 at 6 months and 61.2 at 12 months. 94.4% were either 'satisfied' or 'very satisfied' with their THA at 12 months. Correlations between satisfaction and Patient-reported outcome (PRO) measures were, at 6 months, r = 0.53 for the OHS and r = 0.47 for the FJS-12. At 12 months, correlations were r = 0.49 for both PRO scores, r2 was 0.25. Correlations between satisfaction and overall hospital experience dropped from r = 0.43 at 6 months to r = 0.26 at 12 months.
Conclusion: Both the OHS and FJS-12 demonstrated substantial association with joint-related patient satisfaction following THA. This association was essentially the same in each score, and stable over time. However, only 25% of variance in the patient satisfaction response could be explained by the PRO scores. This highlights that other factors are very important in determining patient satisfaction. Overall hospital experience was also substantially associated with patient satisfaction but the relationship seems transient, weakening over time. To improve patient satisfaction we first need to develop a better understanding of its constituents.

FM 128

Mid-term results of a modular cementless revision stem (Revitan)

Dr. Bertram Rieger, Kantonsspital Baselland, Liestal/CH; Lilianna Bolliger, Kantonsspital Baselland/CH; PD Dr. Karl Stoffel, Kantonsspital Baselland/CH; PD Dr. Thomas Ilchmann, Leonardo – Ärzte für Orthopädie und Traumatologie, Münchenstein/CH; Dr. Martin Clauss, Kantonsspital Baselland, Liestal/CH

Revision surgery after total hip arthroplasty (THA) will increase within the next years. The RevitanTM revision system (Zimmer) was introduced in 2002 with two different distal versions available (curved and straight). So far almost only data on survival of the distal curved version is published showing excellent mid-term results. Aim of this study is to report our mid-term results of the cementless, modular Revitan stem using a straight distal part. Between 09/2006 and 12/2011 67 patients (70 revisions, 3 bilateral) were revised with a Revitan stem. Patients had a prospective clinical and radiological follow-up at 6 and 12 weeks, 1, 2, 5 and every 5 years thereafter. Radiographs were analysed for stem subsidence, distal anchoring of the stem, restoration of the proximal femur according to Böhm, osteolysis and radiolucencies around the stem as well as the cup. Mean age at revision was 71 (43–86) y. 47 patients were male, 33 stems were implanted on the left side. Reasons for stem revision were aseptic loosening of the stem (n = 41, 59%), chronic prosthetic joint infection (PJI n = 22, 31%, n = 12 as one-stage revision) and periprosthetic fracture (n = 7, 10%). The mean follow-up was 4 ± 2 y, no patient was lost to follow-up. 4 patients died during follow-up unrelated to surgery, 1 stem was revised. for aseptic loosening 5 y after revision. 1 patient had a fracture in the Morse-type taper connection of the stem 6y after revision for aseptic loosening. PJI was eradicated in 21 of the 22 cases. Survival rate after 5y with stem revision for any reason and for aseptic loosning was 96 (92–100)% and 90 (82–98)%, respectively. Subsidence >5 mm was found in 8 cases, occurred always in the first 3 months after revision and was independent from reason of revision (p = 0.455). 1 patient was re-revised (lengthening of proximal part) due to excessive subsidence (20 mm^3 months after stem revision) Proximal femoral remodeling was excellent or good in 94% (33 excellent, 25 good). The initial length of the distal integration was 100 mm, 35 stems showed a slight increase of 4 (SD 30) mm. 92% of the stems had no osteolysis and no stem was rated loose at final follow up. The straight distal fixed Revitan stem showed an excellent survival rate comparable to the curved version. Radiological changes over time were scarce and distal integration reliable. Of concern is the fracture of the Morse-type taper.

FM 129

In vitro measurement of micromotion around an uncemented fully coated femoral stem

Valérie Malfroy Camine, EPFL, Lausanne/CH; PD Dr Hannes Rüdiger, Zürich/CH; Prof. Dr Dominique Pioletti, EPFL, Lausanne/CH; Dr Alexandre Terrier, EPFL, Lausanne/CH

Introduction: Primary stability of the femoral stem is essential for the long-term success of cementless total hip arthroplasty. Excessive micromotion at the bone-implant interface promotes aseptic loosening (Engh, 1992). Currently available techniques to evaluate the primary stability of implants rely mainly on displacement sensors. Despite their good precision, they allow only a limited number of measurement points around the stem. The purpose of this study was to extend a µ-CT based technique (Gortchacow, 2012) to measure accurately and at multiple sites interfacial micromotion around a femoral stem.
Methods: One right cadaveric femur conserved in formalin was prepared for implantation by a senior orthopedic surgeon. After reaming of the bone cavity, 1000 stainless steel microspheres were press-fitted on the endosteal bone surface to serve as bone markers. 30 tantalum markers were attached on a straight cementless femoral stem (Corail, Depuy), which was then implanted. A device was developed to apply an axial compressive load on the stem, corresponding to walking activity. This loading device was designed to fit inside a µ-CT scanner. Two successive scans were performed at a resolution of 36 µm: one during loading and one after loading. Micromotion in three dimensions was defined as the displacement of each corresponding bone markers from the loaded scan to the unloaded scan.
Results: We obtained over 550 measurement points spread around the whole stem. 90% of the measurements were performed with an accuracy of 20 µm and the standard error was homogeneously distributed around the stem. Micromotion amplitude varied from 5.5 µm to 50.7 µm. We observed a region with higher micromotion (>40 µm) extending on 2.5 cm on the distal part of the stem. In this region, micromotion was mainly axially directed toward the distal part.
Conclusion: The obtained surface map permits to identify a region with higher micromotion on the distal part of the stem. This underlines the importance of measuring micromotion at multiple sites. The development of such a technique to evaluate accurately implants primary stability and around the whole interface is particularly important in the pre-clinical context. It will allow to study different implant designs or to compare surgical techniques. Finally, it can also be used to validate models used for patient-specific pre-operative planning.

FM 130

Lower extremity muscle weakness in patients with symptomatic hip osteoarthritis

Dr. Bernd Friesenbichler, Schulthess Klinik, Zürich/CH; Dr. Nicola C. Casartelli, Schulthess Klinik, Zürich/CH; Julia Item, Schulthess Klinik/CH; Vanessa Wellauer, Schulthess Klinik, Zürich/CH; Dr. Nicola A. Maffiuletti, Schulthess Klinik, Zürich/CH

Introduction: Lower extremity muscle strength reduction (i.e., muscle weakness) predicts the dependency in activities of daily living (ADL) and was also shown to impact postural stability. Hip pain may induce muscle weakness, muscle atrophy and accordingly gait abnormalities. Therefore, the aim of this study was to quantify lower extremity muscle weakness and gait characteristics in patients with symptomatic hip osteoarthritis.

Methods: Twenty patients (64.5 ± 5 yrs, 173.5 ± 8 cm, 77.0 ± 14 kg, 9 women) scheduled for unilateral total hip arthroplasty due to primary hip osteoarthritis were tested bilaterally. Hip abduction and adduction as well as hip, knee and ankle flexion and extension isometric maximum voluntary contraction (MVC) strength were measured using dynamometry. Lower extremity muscle mass was estimated using bioimpedance analysis. Gait characteristics (single limb support, step time) were measured at self-paced (normal/fast) and fixed speeds (3 km/h) using an instrumented mat and a treadmill, respectively. Data between the involved and uninvolved limbs were compared using a paired Student's t-test ($\alpha = 0.05$).
Results: Hip flexion, extension and abduction MVC strength were significantly lower by 16%, 13% and 9%, respectively, and knee extension MVC strength by 11% in the involved compared to the uninvolved limb. Lower extremity muscle mass was significantly lower by 6% in the involved limb. Single leg support time was significantly shorter by 5%, 4%, and 5% when walking at slow, fast and 3 km/h conditions, compared to the uninvolved limb. Step time of the involved limb was significantly longer by 3% and 2% when walking at slow and fast speeds, respectively, while no difference was observed at the 3 km/h condition.
Conclusion: Patients with symptomatic hip osteoarthritis showed muscle weakness at the hip and the knee, but not at the ankle. Muscle weakness may be partly caused by the lower muscle mass. The gait data revealed limping of the involved side as indicated by the shorter single leg support time and longer step time. Although gait adaptations were shown, they do not seem to have an effect on ankle muscle strength. However, hip and knee muscle weakness may put patients before total hip arthroplasty at a higher risk of falling, together with a higher risk in ADL dependency. These results emphasize the importance of pre-surgical strength training for lower extremity muscles.

FM 131

Clinical improvement and satisfaction after total joint replacement – a prospective 12-months evaluation on the patients' perspective

Dr. Florian D. Naal, Schulthess Klinik, Zürich/CH; Dr. Franco M. Impellizzeri, Schulthess Klinik/CH; Dr. Ulrich Lenze, Universitäts-Kinderspital beider Basel, Basel/CH; Vanessa Wellauer, Schulthess Klinik, Zürich/CH; Prof. Dr. Rüdiger von Eisenhart-Rothe, Klinikum rechts der Isar der TU München/DE; PD Dr. Michael Leunig, Schulthess Klinik, Zurich/CH

Introduction: Total joint replacement (TJR) for the treatment of end-stage hip or knee osteoarthritis is one of the most effective orthopaedic interventions. However, the use of different implants or surgical techniques does not inevitably result in better short-term outcomes or higher patient satisfaction. The short-term assessment of improvements of pain, function, quality of life and satisfaction after TJR is therefore of utmost importance to allow for comparisons of different treatment modalities and approaches. Furthermore, healthcare costs could be reduced by avoiding unnecessary postoperative visits. This study therefore aimed to determine short-term improvements, satisfaction rates, and the patient acceptable symptom state (PASS) after TJR for different patient-reported outcome measures (PROMs).
Methods: This prospective cohort-study included 426 consecutive patients undergoing total hip (n = 193) or knee arthroplasty (n = 233). The following PROMs were completed before TJR, and at 3 months, 6 months and 12 months after surgery, respectively: WOMAC, Oxford Hip or Knee Score, Lower Extremity Functional Scale, University of California at Los Angeles (UCLA) activity scale, and Euroqol 5. Satisfaction rates and the PASS thresholds were also assessed.
Results: THA patients improved quicker and achieved higher outcome scores than TKA patients. Comorbidities were moderately correlated with all PROM values in an inverse direction at all time-points ($r = -0.27$ to -0.47, $p < 0.01$) in both groups. Satisfaction with the result of surgery improved over time. At 12 months, more than 90% of the patients were satisfied or very satisfied with the achieved result. The THA group showed a higher proportion of very satisfied patients than the TKA group at all time-points. PASS thresholds increased over time for all PROMs except for the UCLA.
Conclusion: More than 90% of the patients will be satisfied one year after TJR whereas THA patients recover faster and achieve better outcomes than TKA patients. Cutoff-values defining a successful result in terms of the PASS could be defined for different PROMs at different time-points and can serve as reference for future studies and patient-oriented follow-ups.

FM 132

Long-term results and outcome predictors in one-stage hip reconstruction in children with cerebral palsy

PD Dr. Erich Rutz, Universitätskinderspital beider Basel, Basel/CH; Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; Dr. Carlo Camathias, University Children's Hospital Basel/CH; Dr. Celina Haase/CH; Dr. Stephanie Jünemann/CH; Prof. Dr. Reinald Brunner/CH

Introduction: One-stage hip reconstruction is the gold standard of treatment for hip displacement in children with cerebral palsy (CP). The aim of this study is twofold: (1) to report subjective, objective clinical and radiographic outcomes and (2) to identify outcome predictors and the influence of risk factors (femoral head shape, migration percentage (MP), direction of migration, and age at surgery).
Methods: 168 hip reconstructions (82 right, 86 left) in 121 patients (101 male, 20 female) were performed. All but two patients suffered from spastic quadriplegia including GMFCS (Gross Motor Function Classification System) levels V (68%), IV (23%), III (3%), and II (6%). The mean MP at surgery was 78% ± 23%. The average age at surgery was 11 ± 3.6 years (range 4 to 23 years). The mean follow-up at the time of analysis was 7.3 ± 4.6 years (range 4 to 18 years).
Results: Pain intensity and frequency was reduced significantly. Femoral head shape had no direct effect on the change in pain, Melbourne Cerebral Palsy Hip Classification System (MCPHCS), and the GMFCS Levels. The preoperative MP was the most influential risk factor for postoperative outcome. MP showed a significant association ($p = 0.041$) with pain intensity. The direction of femoral head migration had no effect on pain. Age at surgery had no effect on pain, nor GMFCS improvement. The overall complication rate was 10.5%.
Conclusions: Our data of 168 hip reconstructions with a mean follow-up of 7 years showed statistically significant and clinically meaningful improvements in pain intensity and frequency as well as clinical scores and hip coverage. But analyzing potential risk factors for the outcome showed only the MP to have a relevant influence on postoperative outcomes. The level of femoral head deformity did not influence postoperative outcomes and therefore we recommend hip joint reconstruction even in cases with severe femoral head deformity.

FM 133

Gender differences in patient-rated outcomes in total hip replacement: role of pre-operative status and expectations

PD Dr. Anne F. Mannion, Schulthess Klinik, Zürich/CH; Dr. Franco Impellizzeri/CH; Dr. Florian Naal/CH; PD Dr. Michael Leunig, Schulthess Klinik, Zurich/CH

Introduction: Many studies report gender differences in patient-reported outcome measures (PROMs) in patients undergoing total hip replacement (THR). Few studies have evaluated whether these are explained by corresponding gender differences in important preoperative factors. We asked: 1) Are there gender differences in PROM scores preoperatively and 12 months after THR? 2) Do baseline differences in comorbidity, age, BMI, mental health status and patient expectations explain (statistically) gender differences in PROM scores?
Methods: Preoperatively, 261 patients (129 women, 64 ± 11 y; 132 men, 66 ± 10 y) undergoing THR completed the OHS, WOMAC, SF-12, EQ-5D and an Expectations Questionnaire. Twelve months postoperatively, they completed the questionnaires again and also rated the "Global Treatment Outcome" (GTO).
Results: Preoperatively, women showed significantly (p from 0.048 to 0.001) worse scores than men on most of the PROMs. These gender differences remained when baseline PROM scores were adjusted for BMI, age, comorbidity and SF12 mental health scores. Twelve months postoperatively, the absolute scores for all PROMs were similar ($p > 0.05$) for men and women, which resulted in significantly greater change-scores (preop to 12 mo postop) for the women for some instruments (EQ5D and WOMAC). However, these gender differences disappeared when 12-month scores were adjusted for preoperative values.
Conclusion: Women undergoing THR had worse preoperative PROM scores than did men, and these were not explained by differences in BMI, age, comorbidity, mental health scores or expectations. The greater absolute improvement in PROM scores in women was predominantly the consequence of their worse preoperative scores. The reason for the worse preoperative status in women than men requires further study.

FM 134

Responder = relative effect per patient (REPP) >0.2 – new method externally validated in a large THR multicenter cohort (Eurohip)

Dr. Joerg Huber, Zürich/CH; Prof. Juerg Huesler/CH; Prof. Dr. Klaus Peter Günther, Dresden/DE; Andrew Judge/CH

Introduction: The responder rate describes the rate of patients responding to treatment having a reduction of symptoms and/or disability above the level of minimally clinically important difference. It was defined 2004 by Outcome Measures in Rheumatoid Arthritis Clinical Trials/ Osteoarthritis Research Society International (OMERACT-OARSI). The method is complex to apply and may be a source of error because it depends on a main criterion or two of three subcriterias. A much simpler method to identify a responder is the criterion relative effect per patient (REPP) >0.2. In this study the new method to identify responders REPP >0.2 was externally validated using the OMERACT-OARSI criteria as gold standard in a large multicentre sample of patients having primary total hip replacement across Europe.
Methods: We included patients who were enrolled in the Eurohip study and had complete PROMs with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) follow-ups pre-THR and one year postoperatively with unilateral THR. The EUROHIP study included 1,327 patients who underwent primary THR at 20 European orthopedic centers in 12 nations. The responder rate was calculated for 845 patients of a large multicenter European cohort study with the REPP method ([score before – after treatment]/score before treatment). The patients with a REPP >0.2 were defined as responders. This rate was compared to the one calculated following the OMERACT-OARSI method using receiver operator characteristic (ROC) curve analysis for sensitivity, specificity and percentage of appropriately classified patients.
Results: With the REPP method 85.4% of the patients were classified as respond-ers, applying the OARSI-OMERACT method 85.7%. The new method had 98.8% sensitivity, 94.2% specificity and 98.1% of t he patients were correctly classified compared to the gold standard.
Conclusions: A REPP >0.2 identifies the same patients as responders with very high correlation compared to using the OARSI-OMERACT method. The new method is easier to use having one criterion compared to the OARSI-OMERACT method.

FM 135

Is one stage bilateral total hip arthroplasty reasonable in Swiss DRG. A cost effectiveness analysis

Dr. Michael Uhlmann, Möhlin/CH; Lilianna Bolliger, Kantonsspital Baselland/CH; Dr. Regina Classen/CH; Dr. Martin Clauss, Kantonsspital Baselland, Liestal/CH

There are multiple studies which show that one stage bilateral (OSBL) THA is an equally safe procedure with no more major complications compared to early and delayed two stage bilateral (TSBL). OSBL has several advantages like a single hospital stay, one operation and a shorter rehabilitation. There is no published data about the cost effectiveness of OSBL under Swiss-DRG conditions. Aim of our study is to compare and assess major complications, time of rehabilitation, patient satisfaction and costs between OSBL and TSBL THA. In a retrospective analysis we analyzed 50 patients with bilateral THA operated between 01/12 and 12/14. 24 patients were group to the OSBL group and 26 in the TSBL group. The TSBL group consists of 4 patients with a median interval of 11 days and 22 patients operated within one year. Pre-, intra- and postoperative data until 3 months were collected according standardized protocol. In 01/2015 all patients were contacted by phone and asked about their satisfaction and whether they would choose the same procedure again. The OSBL patients had a lower mean age (63 years vs 71 years) and a lower ASA score (ASA I & II: 100% vs 63%) compared to the TSBL patients. No major complication occurred within the first three months. Minor complications were anemia in 4 (2/2) and luxation in 2 cases (1/1). There was no difference in length of hospital stay (median 9, range 2 to 20 days) and transfusion rate (8% vs 12%), but time of surgery (85 vs 101 min, p = 0.003) and average blood loss per side 324 ml vs 435 ml, p = 0.004) was reduced in OSBL. The distribution rate of discharged to rehab was not different in OSBL and TSBL patients (33% vs 40%). All patients were very satisfied or satisfied and they would choose the same procedure again. By the annual version of SwissDRG Grouper our patients were grouped into 5 different DRGs, including a separate DRG for one stage bilateral THA in each year. Low costs per case were found in patients with short time of surgery, quick recovery and short hospital stay. Using SwissDRG cost-effectiveness in OSBL was higher. Both OSBL and TSBL were found to be safe procedures with low complication rates and excellent patient satisfaction. However, in the OSBL group, operative time, intraoperative blood loss, procedure cost, and hospital stay were significantly reduced compared to TSBL, thus OSBL is a safe and cost effective option for patients with arthritic disease of both hips.

FM 136

Prospective two-year subsidence analysis of 100 cemented polished straight stems

Dr. Wolf Siepen, Kantonsspital Baselland, Bruderholz/CH; Dr. Lukas Zwicky, Kantonsspital Baselland, Liestal/CH; PD Dr. Karl Stoffel, Kantonsspital Baselland/CH; PD Dr. Thomas Ilchmann, LEONARDO – Ärzte für Orthopädie und Traumatologie, Münchenstein/CH; Dr. Martin Clauss, Kantonsspital Baselland, Liestal/CH

Early subsidence (>1.5 mm) in the first 2 years after THA is considered a risk factor for aseptic loosening. The aim of this study was to assess early subsidence rates of a polished, cemented collarless straight stem combined with an uncemented monobloc pressfit cup. 100 hybrid THA were implanted in 97 patients using a cemented polished collarless straight stem (twinSysTM) and a cementless monobloc cup (RM pressfitTM, both Mathys AG Bettlach, Switzerland) in a university affiliated teaching hospital. Mean age at surgery was 79 (68 to 93) years. 51 stems were implanted in female patients, 53 on the right side. Clinical (Harris Hip Score; HHS) and radiological follow-up was done after 6 and 12 weeks, 1 and 2 years. Radiologic evaluation included assessment of progressive osteolysis, radiolucencies and an EBRA-FCA subsidence analysis. No patient was lost to follow-up. One patient died 2 weeks after surgery (upper GI bleeding), another 7 during follow-up unrelated to surgery. Two hips had an early infection (<4 weeks postoperative) and were treated with debridement and retention, both were free of infection at final follow-up. Another 2 patients had a chronic infection (CNS 4 months, and P. acnes 8 months) and were treated with a one-stage exchange. 1 patient sustained a periprosthetic fracture (Vancouver type B1) 3 months after surgery due to a fall, and was treated with osteosynthesis. There was no revision due to aseptic loosening. The mean HHS improved from 53 (14–86) preoperatively to 92 (60–100). Progressive osteolysis was found in 2 cups and 4 stems without clinical symptoms. The EBRA-FCA analysis showed an average subsidence of –0.30 mm (95% confidence interval –0.53 to –0.08) for the stem. 9 patients showed a subsidence of 1–1.5 mm. One patient showed a subsidence of 1.5 mm without further radiological changes. One patient treated for early infection with debridement and retention showed a subsidence of 3 mm in the course of the follow-up and might be at high risk for aseptic loosening. Stems with subsidence >1 mm did not show more radiolucencies than stems without subsidence (p = 0.746). The twinSys stem and RM cup showed excellent clinical and radiologic short term results at 2 years follow-up. With a mean subsidence <1.5 mm, predictive for later aseptic loosening of the stem, the cemented twinSys stem seems to be a reliable implant even in the setting of a teaching hospital resulting in inferior cement mantle quality than in specialised centers.

FM 137

Are functional results of modern bicompartmental knee arthroplasty better than TKA? A 2-year minimum FU prospective comparative study.

Dr Alexandre Lunebourg, Hôpital Ste Marguerite, Marseille/FR; Prof. Sébastien Parratte, Hôpital Ste Marguerite/FR; Dr Matthieu Ollivier, Hôpital Ste Marguerite/FR; Emmanuel Thienpont, Cliniques Universitaires Saint Luc/BE; Prof. Jean-Noël Argenson, Hôpital Ste Marguerite/FR

Introduction: Bicompartimental Knee Arthroplasty (BCA) has been developed to treat bicompartimental arthritis of the knee while preserving the cruciate ligaments and the lateral compartment. The goal is to preserve more normal kinematics of the knee and consecutively better function. Our hypothesis was that the patients operated on with a modern BCA would have better functional results than patients with a Total Knee Arthroplasty (TKA) at a minimum follow-up of 2 years. The goals of this prospective matched-paired study were to compare: 1) The percentage of forgotten knees, and 2) the functional results of the BCA patients versus TKA patients at a minimum follow-up of 2 years.
Patients and methods: In this bicentric (Bruxelles, Belgique; Marseille, France) prospective study, all patients operated on between January 2008 and January 2011 for a BCA were included. These patients were then matched one-to-one based on center, surgeon, timing of surgery, age, sex, and body mass index to patients operated

on for a TKA during the study period. In each group, 34 patients were included. All patients were evaluated at 6 months, one year and every year by an independent observer. A knee was considered as forgotten when the patient was reporting a score of 100/100 at the Forgotten Join Score (FJS-12) and for the different sub-scales of the KOOS. The knee range of motion, the results of the: Knee Society Score, Time and Go up test (TUG) and UCLA scores were also compared in the two groups.
Results: Patients of the BCA group had a greater chance to forget their knee with an OR: 4.64 (IC-95% (1.63–13.21)) and Chi2 = 0.007. No difference was observed between the 2 groups concerning the mean extension. Flexion was greater in the BCA group (130° ± 6° versus 125° ± 8° (p = 0.03)). The Knee Society Knee and Function scores, the TUG and the UCLA scores were also higher in the BCA group compared to the TKA group (p <0.04 for each score).
Conclusion: At a minimum follow-up of 2 years, the results of our series demonstrated that modern BCA with independent implants can restore a better function of the normal knee with a higher percentage of forgotten knees and better functional results than patients after TKA. Longer follow-up is required to confirm these results.

FM 138

Does stemmed tibial component in total knee arthroplasty improve outcomes in patients with a Body Mass Index greater than 30 kg/m^2?

Dr Alexandre Lunebourg, Hôpital Ste Marguerite, Marseille/FR; Prof. Sébastien Parratte, Hôpital Ste Marguerite/FR; Dr Matthieu Ollivier, Hôpital Ste Marguerite/FR; Prof. Jean-Noël Argenson, Hôpital Ste Marguerite/FR

Introduction: Patients with a higher body mass index and smaller tibial component size reported more tibial pain, rate of tibial component loosening and implant migration. Biomechanically, stemmed tibial component have been showed to reduce stresses on the tibial bone. We hypothesized that stemmed tibial component in TKA would improve patient-reported outcomes measured by validated scoring tools at 3 months, 1 years and 2 years after surgery in patients with a BMI greater than 30 kg/m^2.
Methods: We randomized 120 patients into 4 groups (stemmed tibial component versus non-stemmed in tow groups: 30 <BMI <35 and BMI >35 kg/m^2) using either a stemmed cemented tibial component or a standard tibial component. The implant used was the same postero-stabilized cemented implant in both groups. All patients were operated according to the same surgical technique. The stem was always the same (10 mm/100 mm) with a metaphysal cementation. Every patient was evaluated pre-operatively using a Dexa to analyse the osteoporotic status. Patients were evaluated preoperatively, at 3 months, one year and 2 years after surgery using validated subjective functional and quality-of-life (QOL) scores (New KSS, KOOS and SF-12). Radiographic analysis was performed using the radiographic KSS at the different evaluation time points.
Results: We found improvement from preoperatively to 3 months and one year postoperatively in functional scores, QOL. Better functional scores (KSS, KOOS) were observed for the stemmed group in the BMI >35 population. No difference was observed between the two groups with a 30<BMI<35, except for female patients. In the group 30<BMI<35 kg/m^2 considering post-operative pain score >3 as the end-point, not having a stem was factor risk with OR = 4.2; 95% CI [3.45–6.66] in the sub-group of female but not in male patients (OR = 1.3; 95% CI [0.88–2.05]. For the subgroup of female with osteoporotic or osteopenic bone, the OR was 6.5; 95% CI [4.56–7.63]. Considering, in the group with the BMI >35 the odds ratio for the same end-point was 4.5; 95% CI [3.24–6.47].
Conclusions: Our results suggested that a stemmed tibial component can confer a substantial advantage in one and 2-years functional outcomes in patient with a BMI >35 kg/m^2 and in women with an osteoporotic bone with a BMI comprise between 30 and 35 kg/m^2. Complementary studies and longer follow-up are now required to validate the systematic used of a stemmed tibial component in the identified groups at risk.

FM 139

Clinical value of SPECT/CT in the 'unhappy' total knee arthroplasty (TKA) – a prospective study in a consecutive series of 100 painful knees after TKA

PD Dr. Michael Hirschmann, Kantonsspital Baselland, Bruderholz/CH; Felix Amsler, Amsler Consulting, Basel/CH; Helmut Rasch, Kantonsspital Baselland, Bruderholz/CH

SPECT/CT is considered as beneficial hybrid imaging modality in unhappy patients with pain, stiffness or swelling after total knee arthroplasty (TKA).
Introduction: The purpose of this study was to identify typical pattern of bone tracer uptake (BTU) in patients after TKA. BTU was correlated with type of TKA, time from primary TKA, fixation of TKA (cemented or non-cemented) and findings at revision surgery (loose vs well fixed).
Methods: A total of 100 knees (mean age ± SD 70 ± 11 years) of 84 consecutive patients who have previously undergone primary TKA and complained about knee pain or stiffness after TKA were prospectively included. All patients underwent clinical and radiological examination including x-rays and Tc-99m-HDP-SPECT/CT as part of a routine diagnostic algorithm. The diagnosis before and after SPECT/CT and final treatment were recorded. Femoral and tibial TKA position (varus-valgus, flexion-extension, infernal and external rotation) was determined on 3D reconstructed CT. Intensity and anatomical distribution of BTU was determined. Maximum intensity as well as ratios between the respective value and the background BTU (proximal mid-shaft of the Lemur) were recorded (p <0.05). Chi square test, Pearson correlation, t-test for independent sample were performed to identify any correlations between TKA position, BTU and diagnosis.
Results: SPECT/CT changed the clinical diagnosis and final treatment in 85/100 (85%) knees. 33 knees (33%) were surgically revised, 58 knees (58%) non-surgically treated and 9 knees (9%) were scheduled for revision surgery. Intraoperative findings confirmed the preoperative SPECT/CT diagnosis in 32/33 knees (97%). Femoral and tibial TKA loosening as well as progression of patellofemoral OA was correctly diagnosed in 100% of knees. Typical patterns of BTU for specific pathologies were identified. Loose femoral TKA components significantly correlated with increased BTU only at the lateral femoral regions (p <0.05). Loose tibial TKA components significantly correlated with increased BTU at all tibial regions (p <0.05) and around the tibial peg (p >0.01).
Conclusion: The diagnostic benefit of SPECT/CT in patients after TKA has been shown. Typical pathology related BTU patterns were identified, which will improve reporting quality. Due to the benefits in establishing the correct diagnosis SPECT/CT should be part of the routine diagnostic algorithm for patients with pain after TKA.

FM 140

Impact of operation technique in total knee arthroplasty: Gap balancing (tibia first) versus measured resection technique (femur first)

Dr. René Hutter, Kantonsspital Graubünden, Lüchingen/CH; Dr. Vilijam Zdravkovic, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Heinz H. Bereiter, Kantonsspital Graubünden/CH; Dr. Holger Grehn, Kantonsspital Graubünden/CH; PD Dr. Karl Stoffel, Kantonsspital Baselland/CH

Introduction: An important aspect for successful total knee arthroplasty is to obtain symmetric and balanced flexion and extension gaps. Controversy exists regarding the best surgical technique utilized to obtain gap balance. Some surgeons favour the measured resection technique (femur first) in which the transepicondylar, the anterior-posterior, or the posterior condylar axes are used to determine correct femoral component rotation and therefore gap balance. Others account to the gap balancing technique (tibia first) in which the femoral component is positioned parallel to the resected proximal tibia with collateral ligaments equally tensioned to obtain a rectangular flexion gap.
Materials and methods: A total of 111 patients undergoing primary TKR were randomised into two groups: 51 in the femur first and 60 in the tibia first group.The patients were assessed clinically, including operative information and radiologically. The subjective evaluation was based on the patient questionnaire score, oxford knee score and EQ-5D (EuroQol) score. The intra- and postoperative complications were reported. Three patients were lost to the complete follow-up at one year.

Results: At one year there were no significant differences between the groups for clinical outcome, postoperative analysis of the axis in the x-ray nor in the clinical subjective scores. In the tibia first group lower inlays have been implanted more often than in the femur fist group ($p < 0.001$).
Discussion: The superiority of TKA with the tibia first technique in achieving equalised rectangular gaps in extension and flexion does not influence one year postoperative clinical outcome. We conclude that these two operation techniques are equivalent. The tibia first method is a more bone preserving technique considering each bone cut is adapted to the previous and therefore thinner inlays could be placed overall. Compared with the femur fist method, preparing from the femur and tibia is performed independently. The possible overresection has then to be corrected with a thicker inlay.

FM 141

The Cumulated Ambulation Score (CAS) can predict the destination of discharge after primary total knee arthroplasty (TKA)

Dr Georgios Gkagkalis, Hôpital de Zone de Nyon, Nyon/CH; Luis Carlos Pereira, CHUV, Lausanne/CH; Nicole Fleury, CHUV/CH; Estelle Lécureux, Direction médicale, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland/CH; Prof. Dr Brigitte M. Jolles, CHUV, Lausanne/CH

Introduction: Primary total knee arthroplasty (TKA) for osteoarthritis is currently the most commonly performed joint replacement in the United States and according to current projections and the demand for primary TKA is expected to rise about 673% by 2030. The Cumulated Ambulation Score has been successfully validated as a predictor of surgical outcome for hip fracture surgery. The goal of our study was to know if the CAS is able to predict the discharge destination after primary TKA.
Methods: After a sample size calculation and ethical approval, a prospective cohort study was designed and 64 patients were recruited between April 2013 and May 2014. They had all been diagnosed with primary knee osteoarthritis and were waiting for a primary TKA. Surgery was performed to all the patients by the same surgical dedicated knee team using a posterior-stabilized mobile plate implant. The patients were assessed preoperatively and postoperatively at 6 weeks by the EuroQol in five-dimensions questionnaire (EQ-5D), a visual analogue scale (VAS) pain and stiffness score, the WOMAC score, the Knee Society Score (KSS), the University of California Los Angeles (UCLA) activity score and the Risk Assessment and Prediction Tool (RAPT). The Cumulated Ambulation Score (CAS) was calculated postoperatively by a specialized physiotherapist.
Results: All differences found between preoperative and 6 weeks post-operative follow up for every test used were statistically significant ($p < 0.05$) with the exception of the UCLA score. The Cumulated Ambulated Score on day 3 was taken into consideration, showing a clear cut-out value of 10. A dichotomic variable was created which was called CAS10 and with it, we examined the two subgroups that were formed, the group of patients with a CAS score of less than 10 (CAS D3<10) and those with a score equal or higher than 10 on the third postoperative day (CAS D3> = 10). The data analysis showed that there was a strong correlation of the CAS10 score with the patients' discharge destination, home versus rehabilitation center.
Conclusion: The Cumulated Ambulation Score was able to reliably predict the discharge destination after primary TKA. This makes it a precious tool in order to plan and organize in advance the patients' discharge destination and modalities. By avoiding extra days of hospital stay for purely administrative reasons, the length of stay can be shorter and lower, consequently, the costs of postoperative care.

FM 142

Allograft Prosthesis Composite or Mega Prosthesis for reconstruction of the proximal tibia: which works best?

Dr. Daniel Andreas Müller, Uniklinik Balgrist, Zürich/CH; Dr. Giovanni Beltrami, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Dr. Guido Scoccianti, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Dr. Domenico Campanacci, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Prof. Rodolfo Capanna, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT

Introduction: Extensive bone loss of the proximal tibia is a surgical challenging situation to obtain a satisfying limb function. The most common used methods for the reconstruction are Conventional Mega Prosthesis (CMP) and an Allograft Prosthesis Composite (APC). The advantages for the implantation of a CMP seem to be an easier reconstructive technique, reduction of the surgical exposure and minor costs. On the other hand the biologic reattachment of the patellar tendon and the better bone stock favor the use of an APC.
Methods: We retrospectively reviewed a consecutive series of patients who have undergone a reconstruction of the proximal. In all of the 42 patients the same prosthesis system was used and covered by a rotational gastrocnemius flap in 23 cases. 23 patients obtained a CMP, whereas in 19 patients an APC was added. In all of the patients with an APC the graft tendon was sutured to the remaining knee extensor mechanism. In the group of CMP different techniques were used: Direct suture of the tendon (16 patients) and fixation of the tendon to the prosthesis by a plate and screws (7 patients).
Results: After an average follow up of 60 months 9 failures occurred, which were classified according to the Henderson classification (JBJS 2011). Type 1 (soft tissue) failure happened in 2 cases of the CMP group and in 1 of the APC group. Type 4 (infection) failure was observed in 3 of the CMP and 1 of the APC. 4 patients in the CMP group needed a minor additional surgery and 6 a major revision including 4 implant removals and 1 amputation of the lower limb. In the APC group 4 patients had to undergone a minor surgery and 4 a major revision including 2 implant removals and 1 amputation. The overall 10-year implant survival was 78% for the CMP and 84% for the APC. Concerning the functional result no differences between the two groups were found: The CMP showed a mean ROM of 85° compared to 94° in APC ($p = 0.27$) and a mean extension lag of 11° compared to 6° in APC ($p = 0.30$).
Conclusion: Both CMP and APC appear to be satisfactory reconstructive options for massive bone defects in the proximal tibia. There was no significant difference concerning the 10-year survival rate of the reconstruction between the 2 different techniques. The APC was associated with a slight lower complication rate, especially a lower infection rate and less soft tissue failures. Surprisingly the functional outcome of the CMP was comparable to the APC.

FM 143

The outcomes of modern high flexion fixed-bearing unicompartimental knee arthroplasty at a minimum of five-years

Dr Alexandre Lunebourg, Hôpital Ste Marguerite, Marseille/FR; Prof. Sébastien Parratte, Hôpital Ste Marguerite/FR; Dr Matthieu Ollivier, Hôpital Ste Marguerite/FR; Dr Nicolas Dorval, Hôpital Ste Marguerite/FR; Prof. Jean-Noël Argenson, Hôpital Ste Marguerite/FR

Introduction: Unicompartmental knee arthroplasty (UKA) has proven its efficacy in treating knee osteoarthritis and has the advantage of preserving bone stock. To improve function and limit wear, new generation of UKA including high-flexion design and cross-linked polyethylene have been developed. We aimed to evaluate function, quality of life, radiological results and survivorship of this implant at a minimum of five years follow-up.
Methods: From March 2004 to March 2008, 117 medial UKA were consecutively implanted on 107 patients with an average age of 67 years old. The average follow-up was 7 years (5 to 9). Patients were prospectively followed with the Knee Society Score and the Knee Osteoarthrisitis Outcome score (KOOS). The range of movement was evaluated and the radiological alignment measured by an independent observer.
Results: At an average follow-up of 7 years (5 to 9 years), mean Knee Society Knee and Function scores respectively improved from 55 and 62 points pre-op to 96 and 89 points at the latest follow-up. The flexion remains constant from 128° pre-op to 130° post-op. Patients significantly improved all their items of the KOOS. Two knees were revised to total knee arthroplasties at an average of 17 months post-op, one for infection, one for medial tibial plateau fracture. The survivorship using revision for all causes was 98.6% at 7-years follow-up. No aseptic loosening was noted in our series.
Discussion and Conclusion: The results of our series demonstrated that this second generation of implant provides excellent pain relief and allows a high functional level. The absence of aseptic loosening at a minimum follow-up of 5-years follow-up compares favorably with other implants reported in the literature. A careful selection of patients remains essential to reduce late complications following UKA. Longer follow-up will probably demonstrate the advantages of new generation of polyethylene.

FM 144

Analysis of postoperative alignment of three different techniques of total knee arthroplasty in severe varus / valgus deformity

Dr. Roland Camenzind, Bürgerspital Solothurn, Solothurn/CH; Dr. Stefan Rahm, Universitätsklinik Balgrist, Zürich/CH; Dr. Christopher Lenz, Universitätsklinik Balgrist, Zürich/CH; Fiona Köstler, Universitätsklinik Balgrist, Zürich/CH; PD Dr. Mazda Farshad, Universitätsklinik Balgrist, Zürich/CH; PD Dr. med. Sandro F. Fucentese, Universitätsklinik Balgrist, Zürich/CH

Introduction: Most studies agree that after total knee arthroplasty (TKA) a close to neutral axis (± 3°) should be achieved postoperatively. There have been conflicting studies published regarding the precision of the postoperative alignment when comparing the three different techniques which exist; conventional manual instrumented, computer navigated and patient specific instrumented TKA. This study compares the postoperative results of the radiographic alignment in a long standing radiograph in patients with a severe malalignemt (>10° varus/ valgus) preoperatively in the three different techniques of TKA.
Methods: The long standing and lateral knee radiographs of a consecutive series of patients after TKA with a preoperative 10° or more varus or valgus deformity were analyzed retrospectively. All patients received a primary knee arthroplasty in our institution with either a conventional (CON; n = 53), a computer navigated (CN; n = 47) or a computer tomography based patient specific instrumented (PSI; n = 54) technique. The mechanical axis (varus / valgus), the posterior tibial slope and the flexion of the femoral component was measured.
Results: The overall mean preoperative varus deformity was 13.3° (range, 10 to 23; SD 2.9) and the mean valgus was 12.7 (range, 10 to 25; SD 3.1). The overall mean postoperative varus deformity was 2.7° (range, 0 to 13; SD 2.5) and valgus 2.8° (range, 0 to 16; SD 2.9). The mean postoperative varus / valgus deformity of the CON group 2.9° (range, 0 to 13; SD 2.7) / 3.5° (range, 0 to 16; SD 4.5) and in the CN group was 3.0° (range, 0 to 10; SD 2.8) / 2.9 (range, 0 to 8; SD 2.4), of the and of the PSI group 2.1° (range, 0 to 8; SD 1.7) / 2.2° (0 to 5; SD 1.3). In the PSI group there were 20% outliers (>3° varus / valgus) which was relevantly less than in the CON group with 34% and the CN group with 36% outliers. There were no relevant differences in the measurement of the posterior tibial slope and the femoral component.
Conclusion: Patients with a severe >10° varus / valgus deformity have a higher number of outliers than the overall TKA population in literature. In severe varus / valgus deformity the help with the PSI technique seems to have an advantage when compared to the computer navigation and the conventional technique regarding radiographic accuracy. This information should be taken in account when planning the type of technique of TKA.

FM 145

Clinical results 10 years after AMIC in the knee

Dr. Nadine Kaiser, Hopital cantonal Fribourg, Bern/CH; Dr. Matthias Jacobi, Orthopädie Rosenberg, St. Gallen/CH; Taro Kusano, Orthopädie Spital Burgdorf/DE; Prof. Roland Jakob, Hopital cantonal Fribourg/CH; Prof. Dr Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH; Dr. Daniel Petek, Hopital cantonal Fribourg/CH

Introduction: Treating cartilage injuries remains challenging. In the literature, comparable good short- and mid-term results after microfracturing and autologous matrix induced chondrogenesis (AMIC) have been published. In the long term, however, the positive effects of microfracturing alone have been shown to decrease. To our knowledge, there are no long-term results yet available concerning the AMIC technique. We present the clinical results of AMIC procedures in the knee at 10 years of follow-up. We also compare these results with those obtained in the same group after the 2 years of follow-up.
Material and Methods: We included 34 patients in our study who have been treated in our hospital with an AMIC procedure between 2003 and 2006. 27 Patients (79%) were available at final follow-up at an average of 9.6 years (range of 8–11 years). The population's average age at time of follow-up was 47 (range of 24–74 years). There were 9 females and 18 males. All patients completed a Lysholm Score for evaluation of their daily activities and a VAS for pain evaluation preoperatively, at 2 and at 10 years postoperatively. Statistical analysis for Lysholm and VAS included mean values and standard deviation. Significances have been calculated with the two-sided paired t-test. A p-value less than 0.05 was considered significant.
Results: The preoperative Lysholm Score was of 55.76 (SD 17.73) with an average VAS of 5.64 (SD 2.22). At the 2 year follow-up the average Lysholm score was of 83.78 (SD 17.74) with an average VAS of 2.12 (SD 2.28). At the 10 year follow-up, the average Lysholm Score is of 84.72 (SD 12.76) with an average VAS of 2.00 (SD 1.63). Two of the 27 patients had meanwhile implantation of a total knee arthroplasty. There is a significant improvement ($p < 0.001$) in the Lysholm Score and VAS comparing the pre-operative values with the 2 and 10 years postoperative results. There is no significant difference between the results at 2 and 10 years of follow-up (p-value: VAS 0.82 Lysholm 0.898).
Discussion: This study shows constant good results at 10 year of follow-up after AMIC procedures in the knee. In this series, the 10 years of follow-up results at least match the 2 years of follow-up values. This let us conclude that AMIC is a more enduring treatment for cartilage lesions of the knee in the long term compared to microfracturing alone.

FM 146

Unicompartmental arthroplasty for knee osteoarthritis

Dr Roland Gardon, Cabinet privé, Genolier/CH; Dr Antoine Eudier, Department of Orthopaedic Surgery and Traumatology, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland/CH; Dr Eric Ouabo Choudja, Department of Orthopaedic Surgery and Traumatology, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland/CH; Estelle Lécureux, Direction médicale, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland/CH; Prof. Dr Brigitte Jolles-Haeberli, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland, Lausanne/CH

Introduction: Knee osteoarthritis (OA) is a clinical syndrome in which cartilage is affected by progressive breakdown and eventual loss and destruction. Surgical options for femorotibial unicompartmental OA of the knee include tibial or femoral osteotomy, unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA). Clear guidelines regarding selection of the most appropriate treatment for the unicompartmental OA are needed.
Objectives: Primum to assess the benefits and harms of UKA in the treatment of knee osteoarthritis in adults in terms of decreasing pain, increasing knee function, and postponing the need for a TKA. Secundum to compare UKA to other types of treatment such as HTO and TKA.
Methods: We searched for randomised controlled trials (RCTs) and controlled clinical trials (CCTs) comparing the UKA procedure versus TKA or HTO surgeries. Registries were searched for survival rate evaluations. Participants were adult patients with unicompartmental OA of at least grade 2 according to Ahlbäck radiologic criteria or grade 4 according to the Kellgren and Lawrence grading system. Outcomes such as SF-36 or EQ-5D, VAS pain and stiffness, Lysholm score, WOMAC and clinical and radiologic KSS were searched as standardized outcomes measures. Follow-ups of 6 months, 1 year, 5 years, 10 years, and 15 years or longer were searched.
Results: In total, 4855 studies were identified. Only 25 studies were found relevant (after careful reading of all the 4855 abstracts). Looking at the 25 full text articles, we found 12 relevant prospective cohort studies meeting the inclusion criteria. A poor level of methodological rigour in partcular regarding concealment of allocation and assessor blinding was observed in the selected studies.
Conclusions: We can not conclude any preference in terms of Pain, KSS, ROM and Length of the hospital stay when comparing UKA to the TKA. When comparing the UKA to HTO we could not conclude any preference regarding to the Pain, KSS or Survival rate at 5 years. There was a slightly better outomes of Revsion rate and ROM in the UKA group. Based on our results we can not advice uniformly the use of UKA as a method of choice in case of symptomatic medial OA of the knee. More randomised controlled studies with full reporting outcomes, blinding of outcome assessors and correct methodology are required to determine the optimal treatment of advanced unicompartmental OA of the knee.

FM 147

Faster recovery without the use of a tourniquet in total knee arthroplasty

Dr Srdjan Dojcinovic, Clinique Générale, Fribourg/CH; Dr Renaud Maes/CH;Dr Edouardo Godinho/CH

Purpose: Tourniquet application is still common on practice in total knee arthroplasty, despite being associated with several adverse effects.
Patients and methods: 140 patients were randomized into a tourniquet group (n = 70) and non tourniquet group (n = 70). All operations well performed by the same surgeon and follow up was fot 1 year. Primary outcomes were functional and clinical outcomes, as evaluated by KOOS and knee ROM. Secondary outcomes were intraoperative blood loss, surgical time, postoperative blood loss, surgical time and visibility, postoperative pain, analgesic consumption, transfusion requirements.
Results: Patients in the non-tourniquet group showed a better outcome early knee ROM from surgery to week 6. No difference was detected at the 6 and 12 month follow-ups. Postoperative pain and analgesic consumption were less when tourniquet was not used. Surgical time was similar between two groups. Intraoperative blood loss was greater when not using a tourniquet, but no postoperative transfusions were required.
Conclusion: This study shows that TKA without the use of tourniquet results in faster recovery in terms of better functionnal outcome and improved knee ROM. Furthermore reduced pain and analgesic use were registered and no intraoperative difficulties were encountered.

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Quality of life and subjective outcome 10 years after innex UCOR primary total knee arthroplasty

Dr. Anna Rienmüller, Medizinische Universität Wien, Wien/AT; Dr. Stefan Preiss, Schulthess Klinik, Zürich/CH; Dr. Tomas Drobny, Schulthess Klinik Zürich, Zürich/CH; Dr. Thomas Guggi, Schulthess Clinic Zuerich, Zürich/CH

Introduction: As life span is increasing, expectation in quality of life and subjective functionality of total knee replacement is becoming more important. Outcome measurement is increasingly the focus of attention in current health-care debates. The purpose of the present study was to analyze the clinical and subjective 10 year outcome after total knee replacement in all patients undergoing primary total knee arthroplasty using our standard Innex UCOR prosthesis (Zimmer; Warsaw) in 2002.
Methods: 411 total knee replacement in 383 patients were performed in 2002 in our institution, 253 women and 139 men, with a mean age of 86.9 (range 31–87) at time of implantation underwent surgery. All patients were analyzed for clinical (ROM, stability, VAS) and radiological outcome (radiolucency, loosening), as well as Knee Society Score (KSS) preoperatively and 10 years postoperatively. For patient related outcome the SF-36 was used, additionally general satisfaction with the knee surgery result and overall satisfaction with general health in comparison to the preoperative state were examined.
Results: At 10 years follow up in 2012, 216 patients were available for clinical and radiological evaluation as well as completion of quality of life and satisfaction questionnaires. 20 patients (4,9%) were revised, 9 patients switched to another hospital, 40 patients answered the questionnaire by phone, 91 patients had died before 10 years follow up, 36 patients (8,8%) were lost to follow up. Preoperative KSS showed no significant difference between women and men. Also no significant difference was found regarding range of motion postoperatively (mean 120°, range between 85–150) and revision rates. Significantly improved scores were seen for postoperative KSS with a mean of 160.1 (range 10–200) in men and 132 (range 10–200) in women. 88% of patients were very satisfied with surgery results but 5% of women and 1% of men were very unsatisfied with their outcome. No difference was found in overall satisfaction with general health.
Discussion: In conclusion, we can state that patient satisfaction regarding function and quality of life after total knee replacement remain fulfilled 10 years after total knee replacement. Nevertheless, 12% of patients remain not fully satisfied, although clinical and radiological outcome parameters may not differ from subjectively satisfied patients, especially in women. Future attempts to address and improve this group of patients remain necessary.

FM 149

Knee arthrodesis using modular Wichita fusion nail

Anaïs Luyet, Lausanne/CH; Dr Nicolas Gallusser, Lausanne University Hospital, Lausanne/CH; PD Dr Olivier Borens, Lausanne University Hospital, Lausanne/CH

1. Introduction: Indications for knee arthrodesis include severe instability, inadequate soft tissue coverage or extensor mechanism deficit. The most frequent indication is currently salvage of failed TKA when revision arthroplasty is contraindicated. Different methods are used like intramedullary nail, plates and external fixator. The overall fusion rate is 50% to 100%, best achieved by plates and nails. The complication rate reaches a mean of 33%. This includes infection, peri-implant fracture or fracture of the implant and delayed or non-union.
2. Methods: We retrospectively reviewed 22 cases of knee arthrodesis by Wichita® fusion nail (WFN; Stryker Orthopedics, Mahawah, NJ) between 2005 and 2013 performed by a single surgeon. We assessed fusion rate time to fusion, complications, and ambulatory status.
3. Results: There were a total of 21 patients and 22 knee studied. The average age of the patients was 63.8 years (20–93). 9 were male and 13 were female. The average follow up is 5.6 years (14 months–10 years). Six patients were lost to long-term follow-up. The most common indication was TKA failure (68%) due to infection (86%), one had aseptic loosening and one had a peri-prosthetic fracture. The other reasons were congenital knee dislocations (9.2%), septic arthritis (9.2%) and secondary to tibial ORIF (13.6%), two for mixed instability and one for chronic tibial osteomyelitis and important cutaneous defect. In septic cases, the arthrodesis was performed as a two-stage procedure. Primary fusion rate was 81.25%. Mean time to fusion was 6.6 months for these patients. 3 had rearthrodesis for non-union. The complications included one suspicion of infection treated by reoperation by WNF, one peri-prosthetic fracture treated by ORIF and three cases of pseudarthrosis for which plates were used. All patients walk full weight bearing.
4. Discussion: In the literature, bony fusion after arthrodesis by modularly nail is acquired in 78.81% (66–100) of the cases in average 7.5 months (3.6–16). In this study, the complication rate is 22.7% and all the cases of pseudarthrosis fused after one reoperation. Arthrodesis with WFN provides 81.25% primary fusion rate at 6.6 months. Theses are satisfactory results that can be compared to the literature. The clinical outcome is satisfactory as well; all patients are walking on a fused arthrodesis at last follow-up.

FM 150

Does prosthesis design affect the need for secondary resurfacing in total knee arthroplasty?

PD Dr. Michael Hirschmann, Kantonsspital Baselland, Bruderholz/CH; Felix Amsler, Amsler Consulting, Basel/CH; Lucas Werth, Kantonsspital Baselland, Bruderholz/CH

Introduction: The purpose of this retrospective consecutive study was to compare the rate of secondary resurfacing in consecutive series of five different TKA systems. It was our hypothesis that different brands of TKA show different rates of secondary resurfacing.
Methods: A retrospective study was performed on data from patients who underwent TKA without primary patellar resurfacing from 2004 to 2012 in an university affiliated hospital. The study cohort included 784 patients (m:f = 302:482, mean age at surgery ± SD 71 ± 10) operated with TKA during this period. Five different cruciate-retaining TKA systems were used in consecutives series. These were the following: A) Triathlon, Stryker, Switzerland (n = 296), B) PFC Sigma, DepuySynthes, Switzerland (n = 215), C) LCS, DepuySynthes, Switzerland (n = 80), D) Balansys, Mathys, Bettlach, Switzerland (n = 129), E) Duracon, Stryker, Switzerland (n = 64). Data was retrospectively obtained from our different hospital archives. Patients demographics, age at surgery, type of total knee arthroplasty were noted. In addition, the data were screened for a secondary resurfacing in each patient. On anterior-posterior, lateral and skyline view radiographs different measurements were performed. TKA component position was assessed on radiographs with respect to “The knee society total knee arthroplasty roentgenographic evaluation and scoring system (TKA-RESS). Pearson Chi square test was used to compare differences between groups ($p < 0.05$). There was no significant difference between the groups in terms of age, gender, and radiological outcomes.

Results: Twenty-six of 784 patients (3.3%) underwent secondary resurfacing due to patellofemoral pain during follow-up. In group A four of 296 patients (1.4%), in group B fifteen of 215 patients (7%), in group C four of 80 patients (5%), in group D two of 129 patients (1.6%), in group E one of 64 patients (1.6%) underwent secondary patellar resurfacing during follow-up. There was a statistically significant difference between group B and A, D and E as well as between group C and A, D and E ($p < 0.001$).
Conclusion: Prosthesis design influences the need for secondary resurfacing of the patella. It was shown that the rate ranges from 1 to 7%. The highest rate for secondary resurfacing was found in the PFC Sigma TKA.

FM 151

Is trochlear dysplasia rather dupratrochlear? A comparison of Dejour's classification on conventional radiographs and MRI

Dr. Philippe Tscholl, Universitätsklinik Balgrist, Zürich/CH; Dr. Florian Wanivenhaus, Universitätsklinik Balgrist, Zürich/CH; PD Dr. med. Sandro F. Fucentese, Universitätsklinik Balgrist, Zürich/CH

Introduction: Trochlear dysplasia is one of the major risk factors for lateral patellar instability, which is most frequently described by the classification type A to D published by Dejour D et al. in 1998. They differ in the presence or absence of medial condyle hypoplasia and supratrochlear spur. Recent findings highlight a low reproducibility between grading of trochlear dysplasia – especially for type B to D – on lateral conventional radiographs (CR) and axial MRI. This is most probably due to a lack of a clear definition at which femoral height the femoral trochlea needs to be evaluated on axial MRI. The aim of the study is to evaluate the most appropriate and reproducible axial image on MRI that correlates best with the grading of trochlear dysplasia on CR according to Dejour.
Methods: 263 knees with histor of single or recurrent patellar dislocation are included in this study. Trochlear dysplasia is measured according to Dejour on lateral CR and on axial MRI scans, which are measured on three different levels: L1) 3 cm above joint line, L2) at the most proximal image where the "Roman arch" is seen, L3) where the patella has the largest horizontal diameter, which is postulated as the approximate height of patellofemoral engagement in early flexion.
Results: Best agreement for trochlear dysplasia (type A-D and no dysplasia) between CR and MRI was found for L3 (43.4%), followed by L2 (31.2%) and L1 (23.2%; $p < 0.005$). If the femoral trochlea was distinguished in mild (type A) and severe (type B-D) dysplasia, best agreement also was found for L3 (80.6%; L2: 68.6%, L1: 56.6%; $p < 0.05$). No significant difference was found, if trochlear dysplasia with (type B/D) and without supratrochlear bump (type A/C) were compared (L1: 63.2%, L2 71.1%, L2 68.2%). L3 was found to be more proximal in >95% of the cases than L2 and L1.
Conclusions: More proximal measurements on axial MRI show better agreement with lateral CR, since all but one characteristics for a trochlear dysplasia type B-D (supratrochlear spur and double contour) are found proximally to the fully cartilaginous trochlea.

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Trunk muscle activation during walking with increased trunk sway to reduce knee loads

Dr. Corina Nüesch, University Hospital Basel, Basel/CH; Dominik Laffer/CH; PD Dr. Annegret Mündermann, University Hospital Basel, Basel/CH

Introduction: The external knee adduction moment has been associated with the presence, severity and rate of progression of medial compartment knee osteoarthritis (OA) [1, 2]. Among other interventions, walking with increased mediolateral trunk sway reduces the knee adduction moment in healthy subjects and in patients with knee OA [3]. However, the effects of walking with increased trunk sway on the trunk muscle activation are unclear. We tested the hypothesis that walking with increased trunk sway reduces the first peak knee adduction moment (pKAM) and increases the core muscle activation in healthy subjects.
Methods: 3D gait data with simultaneous surface electromyography (EMG) of gluteus medius, rectus abdominis, external oblique and erector spinae muscles were collected in 15 healthy subjects (age: 30.0 ± 8.7 years; weight: 70.5 ± 11.7 kg; height: 1.77 ± 0.08 m) for walking normal and with increased mediolateral trunk sway. All EMG signals were normalized to their respective mean intensity during a gait cycle of normal walking. For each trial, we calculated the mediolateral trunk sway amplitude, pKAM, and mean EMG intensity in the 100 ms prior to pKAM. Differences between the two conditions were analyzed using paired t tests ($\alpha = .025$).
Results: Walking with increased mediolateral trunk sway (+8 ± 4°; $P < .001$) was associated with lower pKAM (–18 ± 12%; $P < .001$), greater contralateral abdominal external oblique (+74 ± 59%; $P < .001$), and lower ipsilateral gluteus medius EMG intensity (–18 ± 49%; $P = .018$).
Conclusion: As previously shown [3], walking with increased mediolateral trunk sway is an effective way to reduce pKAM. It reduces the activation of the ipsilateral gluteus medius muscle, likely due to the displacement of the center of mass towards the hip joint. However, it led to greater activation of the contralateral external oblique muscle which is presumably required to stabilize the trunk. Hence, potentially greater stress on selected trunk muscles should be monitored in gait retraining programs with increased mediolateral trunk sway.

References:
1 Mündermann et al. Arthritis Rheum. 2004;50:1172–8.
2 Chehab et al. Osteoarthritis Cartilage. 2014;22:1833–9.
3 Simic et al. Arthritis Care Res. 2012;64:1545–53.

FM 153

The hundred most-cited publications in orthopaedic knee research

Dr. Sufian S. Ahmad, Bern/CH; Dr. Sandro Kohl, Inselspital Bern, Bern/CH

Background: Despite its limitations, citation analysis remains one of the best currently available tools for quantifying the impact of articles. Bibliometric studies list the "best-sellers" in a single location, and they have been published frequently in many fields during recent years. The purpose of the present study was to report the qualities and characteristics of citation classics in orthopaedic knee research.
Methods: The database of the Institute for Scientific Information (ISI) was utilized for identification of articles published from 1945 to March 2014. All knee articles that had been published in sixty-five orthopaedic and twenty-nine rheumatology journals and that had been cited at least 200 times were identified. The top 100 were selected for further analysis of authorship, source journal, number of citations, citation rate (both since publication and in 2013), geographic origin, article type, and level of evidence.
Results: The publication dates of the 100 most-cited articles ranged from 1948 to 2007, with the greatest number of articles published in the 1980s. Citations per article ranged from 2640 to 287. All articles were published in eleven of the ninety-four journals. The leading countries of origin were the U.S. followed by the U.K. and Sweden. The two main focus areas were sports traumatology and degenerative disease. The number of citations per article was also greatest for articles published in the 1980s. Basic research articles were cited more quickly, but not more often, than clinical articles. Most articles represented Level-IV evidence, followed by Levels II, III, and I.
Conclusions: This bibliometric study is likely to include a list of intellectual milestones in orthopaedic knee research. It is apparent that a high level of evidence is not mandatory for an article to gain a large number of citations. Bibliometric reports provide a reflection of the quality of cited research published in a specific field and should therefore provoke thinking within the scientific community.

P 1

Stainless steel wire versus fibrewire suture cerclage fixation to stabilize the humerus in total shoulder arthroplasty

Dr. Niklas Renner, Universitätsklinik Balgrist, Zürich/CH; Dr. Karl Wieser, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Dominik Meyer, Universitätsklinik Balgrist, Zürich/CH

Hypothesis: No. 5 FiberWire (Arthrex, Naples, FL, USA) cerclage (FWC) and 1.25-mm stainless steel wire cerclage (SSWC) are biomechanically similar in resistance to prosthetic subsidence in shoulder arthroplasty.
Methods: In this laboratory bench study, 3 different surgical knot configurations (4-throw knot, cow hitch, and simple hitch) using a No. 5 FWC were evaluated and compared with a 1.25-mm SSWC. First, distraction tests were performed using bovine femoral cortical half shells mounted on a testing jig. Cerclage tightening, load to a 3-mm gap opening, and load to total failure were measured. Second, uncemented humeral prosthetic stems were inserted into an experimentally split humeral medullary canal, secured by the cerclage. After 100 N of preloading, the prosthesis was advanced into the humerus at a speed of 0.2 mm/s, and resistance during subsidence up to a penetration depth of 10 mm, as well as gap opening, was measured.
Results: Tightening force showed higher values for SSWC (618 N) than FWC (131-137 N) ($P < .001$). Load to total failure was comparable among the 3 different FWC knots (2,642-2,804 N), which were significantly stronger than SSWC (1,775 N, $P < .001$). At 3 mm of distraction, SSWC (1,820 N), cow hitch (1,803 N), and single-throw hitch (1,709 N) performed significantly better than a 4-throw knot (1,289 N) ($P < .01$). Subsidence testing showed no difference in force restraint or gap opening between the best FWC and SSWC.
Conclusions: FWCs appear, in vitro, equally suitable to steel wires to stabilize nondisplaced periprosthetic humeral fractures. To actively reduce a displaced fracture, steel wires may still be the first choice.

P 2

Postoperative rotator cuff healing: prospective comparison of MRI and US

PD Dr Alexandre Lädermann, Hôpital de La Tour, Genève/CH

Introduction: The ability to determine tendon healing after arthroscopic rotator cuff repair (ARCR) is difficult. Currently, magnetic resonance imaging (MRI) is considered the gold standard. However, ultrasound (US) is more cost-effective and easy to use in the office. The objective of this study was to prospectively compare the diagnostic reliability of MRI versus US for assessing tendon healing after ARCR.
Materials: From October 2012 to February 2013 patients with a full-thickness tear of the postero-superior rotator cuff who had an ARCR were prospectively followed. At six months postoperative all patients had an MRI and US to assess tendon healing. The presence or absence of healing was graded I to V according to the Sugaya criteria. Studies were reviewed by two orthopaedic surgeons and a musculoskeletal radiologist and an Intra- and Inter-observer analysis was performed.
Results: 62 patients (30 male) with a median age of 56.5 years (range 39 to 75 years) were included in the study. Based on US examination the Sugaya grade was type I in 0 (0%), type II in 45 (72.6%), type III in 4 (6.5%), type IV in 5 (8.1%), and type V in 8 (12.9%). On MRI the Sugaya grade was type I in 2 (3.2%), type II in 38 (61.3%), type III in 7 (11.3%), type IV in 5 (8.1%), and type V in 9 (14.5%). The correlation between US and MRI both performed by the radiologist was 0.8 ($p <0.001$) and the intra-observer k value was 0.62 (±0.09). According to the correlation between US and MRI both performed by the orthopaedic surgeons, the inter-observer k value was 0.57 (±0.09) and 0.75 (±0.07) for the first and second interpretation respectively. The correlation between US performed by radiologist and MRI interpretation by orthopedist surgeon was 0.7 ($p <0.001$) and 0.73 ($p <0.001$) with inter-observer k value of 0.3 (±0.09) and 0.4 (±0.09) respectively.
Conclusion: Postoperative US is comparable to MRI in the assessment of rotator cuff tendon healing following ARCR and demonstrates good intra- and inter-rater reliability.

P 3

Calcaneum and Achillis tendon allograft for bony and tendinous Insufficiency of the posterosuperior rotator cuff in young patients

Dr Adrien Schwitzguébel, FORE (fondation de La Tour pour la recherche et l'enseignement), Grand-Lancy/CH; PD Dr Alexandre Lädermann, Hôpital de La Tour, Genève/CH

Introduction: Combined bony and tendinous insufficiency of the posterosuperior rotator cuff can be easily managed with reverse shoulder arthroplasty in old patients. However, there is currently no satisfying option in young patient. This case report presents an original technique of reconstruction.
Case report: We evaluated a 44 years old woman who sustains 12 months ago a fracture of the greater tuberosity following a right glenohumeral dislocation. An open reduction and stabilization of the greater tuberosity with a "Hawkins" tension band was performed in another institution. The patient presented persistent pain and pseudoparalysis. The radiologic evaluation demonstrated a massive humeral head bone loss (osteonecrosis of the greater tuberosity) and an associated posterosuperior rotator cuff lesion. Electroneumyography was normal. As in our hands a simple repair of the cuff do not allowed in such a situation to recover active forward flexion, a fresh frozen allograft of calcaneus and Achilles tendon was used to compensate this combined deficiency. At 5 months follow-up, the patient was pain free, had complete range of motion, a SANE score of 95 and presented radiologically an integrated allograft and competent rotator cuff.
Conclusion: Calcaneus and Achilles tendon allograft might be a surgical option in management of combined bony and tendinous insufficiency of the rotator cuff.

P 4

Early plate removal after locking plate osteosynthesis of proximal humeral fractures. A minimum of two-year follow-up

Dr. Sören Waldmann, Bürgerspital Solothurn, Solothurn/CH; Dr. Michael Schär, Orthopädie und Traumatologie, Universität Bern, Bern/CH; Dr. Ulf Riede, Bürgerspital Solothurn, Solothurn/CH

Introduction: Open reduction and internal reduction of proximal humeral fractures is the gold standard and leads to good and excellent results. There is a reported high number of intra- and postoperative complications using this implant. Our hypothesis was, that early plate removal may reduce the postoperative complication rate, especially complications associated with avascular necrosis to the humeral head. The aim of this study was to evaluate the impact of plate removal as early as 6 months postoperatively on the clinical as well as radiographical outcome two years after initial surgical treatment.
Methods: A total of 131 consecutive patients (mean age: 67 ± 13.2 years, male/female: 36/95) with a closed proximal humerus fracture were treated by a single surgeon at our institution with open reduction and internal fixation using the PHILOS locking plate system (Synthes, Switzerland) from January 2008 to December 2013. Patients with two-, three- and four-part fractures according to Neer were included into this study. All the patients received a similar postoperative physical therapy treatment. In 88 patients (mean age: 62.5 ± 11.8 years, male/female: 28/60), a plate removal was recommended six months after surgery and performed xx-xx months postoperatively. In 37 patients, no removal was performed. After a minimum follow up of 24 months, clinical results including range of motion, Constant Score, Subjective Shoulder Value, DASH, SF-36, as well as radiographic results were assessed.
Results: Six revision surgeries were necessary in our group of 131 (4.5%) of open reduction and internal fixation of the humeral head group due to early postoperative complications. Regarding the group of 88 locking plate removals, no intra- and postoperative complications were reported. All fractures were healed. Six weeks postoperative after plate removal, all patients reported a significant subjective improvement of the operated shoulder. No further surgery was necessary in this group.
Conclusion: Locking plate removal after 6 months postoperative is a save surgical procedure and may reduce secondary complications. The removal of the implants leads to a significant improvement of the shoulder function at the stage of the postoperative rehabilitation phase.

P 5

Assessment of ligaments, plicae, and cartilage in pediatric and adolescent elbow MRI

Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; PD Dr. Sebastian A. Müller, University Hospital Basel, Basel/CH; Dr. Carlo Camathias, University Children's Hospital Basel/CH

Introduction: Elbow injuries in young athletes are becoming an increasing concern for orthopedic sports medicine specialists. The most frequent are ligament injuries and cartilage injuries such as OCD. While their open and arthroscopic treatments are well described, imaging is complicated. The purpose of this study was to assess MRI in imaging the affected anatomy in pediatric and adolescent patients.
Methods: 65 elbow MRI studies were selected and analyzed "as are". First, we tested if the collateral ligaments were clearly discernable, and, if so, measured their size. Second, we specifically looked for cartilage damage including pseudodefects, and for posterolateral plicae. Third, we tested if these endpoints differ between patients with open and closed physes. All assessments were done in independent duplicate.
Results: 9 MRIs (13%) did not allow unequivocal assessment of any of the endpoints because of poor quality or artefacts. 29 patients were skeletally immature with at least one open physis, 27 had all physes closed. In skeletally mature patients, the radial and ulnar collateral ligament were clearly discernable in 94% and 77%, measuring 1.5 ± 0.6 mm and 1.9 ± 0.6, compared to 55% and 59% in the immature patients with a mean thickness of 1.1 ± 0.6 and 1.4 ± 0.6 mm. This is consistent with a significant difference for both discernability and size ($p < 0.05$). 65% of the mature patients showed a posterolateral plica with a maximum extension of 2.2 ± 1.7 mm, compared to 41% ($p = 0.082$) of the immature patients (1.1 ± 1.2 mm, $p = 0.006$). 100% of patients with OCD had a posterolateral plica, compared with only 47% of those without OCD ($p = 0.03$). In OCD the plica was significantly larger with 4 ± 0.7 mm compared to 1.3 ± 0.2 in those patients without OCD ($p = 0.001$). 42% of all patients with closed physes had a posterior pseudodefect in the capitellum, compared to 17% in the skeletally immature patients ($p = 0.08$).
Conclusion: Elbow MRI in pediatric and adolescent patients is associated with a considerable amount of problems. 1 in 10 cannot be assessed reliably. Assessment of the collateral ligaments is limited. Posterolateral plicae are more frequent and larger in size in patients with OCD, implicating their involvement in the pathology. Lastly, pseudodefects are encountered in 42% of adolescents but only 17% of immature patients. Thus any irregularity in the cartilage of the pediatric elbow patient should be further assessed with the utmost diligence.

P 6

A rare case of corrective humeral osteotomy for a malpositioned gleno-humeral arthrodesis with an intraoperative 3D CT guided navigation system (O-Arm©)

Dr Diego Davanzo, Regional Hospital of Lugano, Lugano/CH; Dr Francesco Marbach, Regional Hospital of Lugano/CH; Dr Christian Candrian, Regional Hospital of Lugano/CH

Objective: The correct position of a shoulder arthrodesis is considered to be: 30° abduction, 30° anteversion and 25–30° internal rotation. We report a rare case of a patient with a painful shoulder arthrodesis and a malposition of the arthrodesis treated with a subcapital humeral corrective osteotomy using an intraoperative O-Arm.
Methods: A 40 years old women, after a skiing injury had a dislocation of her right shoulder. In the following 2 years, 7 operations were performed in order to stabilize her recurrent instability without success and an open shoulder arthrodesis was performed in total 2 years after her skiing accident. After one year of satisfaction, she started to complain pain , "impossibility to relax her shoulder" and unsatisfaction of her "shoulder" position. Clinically she presented a scapula alata, a 60° of abduction, 35° of anteversion and 25° of internal rotation of her right arm. Radiologically the arthrodesis was healed. After a precise preoperative planning, we therefore performed the hardware removal, a subcapital osteotomy, a resection of the planned wedge and a temporary fixation of the arthrodesis with K-wires. The intraoperative position of the humerus in relation to the scapula was verified with the O-Arm. The definitive fixation was performed with a locking plate. We documented up to 1 year after the operation preoperative and postoperative Constant score and Dash score.
Results: One year after the operation, subjectively the patient felt much better, the preoperatively presented discomfort disappeared, she was able to "relax her shoulder". Clinically the position was how planned preoperatively with about 30 degree of anteversion, 35 degrees of abduction, the internal rotation was unchanged. The osteotomy showed bony healing only after 7 month. One year after the operation the Constant score improved from preoperative 16 to 35 and the Dash score from preoperative 68 to 41.
Discussion: This is the first report in literature of a corrective subcapital osteotomy after a shoulder arthrodesis. The intraoperative use of the O-Arm allowed to verify the otherwise very difficult to assess position of the humerus in relation to the scapula. The intraoperative use of a O-Arm is not only useful for a corrective osteotomy but should be also considered for primary shoulder arthrodesis in order to avoid malpositioning.

P 7

First 50 pediatric and adolescent elbow arthroscopies – analysis of indications and complications

Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; PD Dr. Sebastian A. Müller, University Hospital Basel, Basel/CH; Dr. Carlo Camathias, University Children's Hospital Basel/CH

Introduction: Elbow arthroscopy is a challenging, yet extremely productive procedure in orthopaedic sports medicine. The severely confined anatomy of the pediatric and adolescent elbow is particularly prone for perioperative complications. This study focuses on the indications and complications of the first 50 elbow arthroscopies in skeletally immature patients done in a specialized pediatric orthopaedic department. The purpose of this study was to analyze indications and complications in pediatric and adolescent elbow arthroscopy. We hypothesized that the complication rate in these patients is similar to adults.
Methods: Data on 50 consecutive elbow arthroscopies were prospectively gathered in a dedicated database and retrospectively analyzed for indications and perioperative complications. All procedures were performed by a surgeon trained in orthopaedic sports medicine.
Results: 26 boys and 24 girls with a mean age of 13.6 ± 3.3 years at the time of surgery and a minimum follow-up of 1 year were included. 58% were treated for osteochondritis dissecans, 24% for arthrofibrosis, 14% for a congenital disorder, and 4% for a posttraumatic problem other than arthrofibrosis. The complication rate was 8%, including 3 cases of transient neuropraxia and one superficial wound infection. There were no major complications such as septic arthritis, vascular injury, or permanent nerve damage. All complications resolved fully with conservative treatment, no revision were required.
Conclusion: While osteochondritis dissecans is still the leading reason for such surgery, fractures and posttraumatic conditions are becoming more important. With a rate of 5% to 8% of minor, fully resolving complications such an increase is not a reason for concerns.

P 8

Selective supraspinatus atrophy due to suprascapular nerve compression

Dr Diogo Vieira Cardoso, Hôpitaux Universitaires de Genève/CH; Dr Emilie Paulin, Hôpitaux Universitaires de Genève/CH; Dr Gregory Cunningham, Hôpitaux Universitaires de Genève, Genève/CH

We present the first reported case of a selective supraspinatus atrophy subsequent to suprascapular nerve compression by a paralarbal cyst located in the spinoglenoid notch. This 58-year-old right-handed manual worker female, presented to a specialized shoulder consultation with severe progressive pain in her shoulder with failed conservative measures. Clinical exam revealed isolated limitation in active abduction and a painful Jobe test. Arthro-MRI showed a 12x10 mm paralabral cyst associated to a superior labral anterior to posterior (SLAP) II lesion associated with a Goutallier stage IV isolated supraspinatus atrophy but no rotator cuff tear. The patient underwent arthroscopic cyst decompression and biceps tenodesis, and presented satisfactory pain relief at 6 months follow-up with a constant score of 76 points and an SSV of 50%. control arthro-MRI showed no recurrence of the cyst and even regression of the fatty infiltration to stage II. The presented case confirms the already known association between SLAP lesions and paralabral cysts and goes in favor of the debated reversibility of fatty infiltration. Most of all, it reveals the existence of a previously unknown type of lesion due to suprascapular nerve compression. Because of its anatomical course, compression of this nerve involves either both supraspinatus and infraspinatus atrophy or isolated infraspinatus atrophy. Etiological

hypothesis for an isolated supraspinatus atrophy could be either an aberrant nerve branch to the infraspinatus muscle which avoids the spinoglenoid notch, or a double nerve supply to this same muscle by the axillary nerve.

P 10

Carpal Tunnel Syndrome – is the Internet providing comprehensive patient information?

Dr. Adrian Palma, UniversitätsSpital Zürich, Zürich/CH; Dr. Florian Samuel Frueh, UniversitätsSpital Zürich, Zürich/CH; Dr. Dimitri Raptis, UniversitätsSpital Zürich, Zürich/CH; Dr. Christiana Graf, UniversitätsSpital Zürich, Zürich/CH; PD Dr. Maurizio Calcagni, UniversitätsSpital Zürich, Zürich/CH

Purpose: To assess the quality of patient information about carpal tunnel syndrome (CTS) in the Internet. Patients suffering from Carpal Tunnel Syndrome actively search the Internet for medical information. The World Wide Web represents the main source of patient information. Very little is known regarding the quality of patient information in the Internet.
Material and Methods: The qualitative and quantitative assessment of the websites was performed with the modified Ensuring Quality Information for Patients (EQIP) tool (36 items). 500 websites containing information on CTS treatment procedures were identified through Google, Bing, Yahoo, Ask.com and AOL. Duplicates and irrelevant websites were excluded.
Results: 110 websites were assessed. Only 5 websites addressed >20 items and the scores tended to be higher for encyclopedias, educational and scientific sites compared to websites developed by the industry and physicians. The median number of items from the EQIP tool was 15, and quantitative postoperative morbidity risk estimates were available in 25%. Major complications such as median nerve injury were reported in only 30% of the websites.
Conclusion: This analysis demonstrates several significant shortcomings in the quality of the information provided to patients suffering from CTS according to the EQIP-instrument. To the best of our knowledge, assessment of available information for CTS and its treatment has never been performed with a validated tool. There is acute community need to provide an interactive, informative and educative website for CTS surgical procedures. The website should be compatible with international quality standards for hand surgery procedures.

P 11

Carpal tunnel syndrome due to localized hypertrophic neuropathy

Dr. Mauro Maniglio, HFR Fribourg – Hôpital Cantonal, Fribourg/CH; Dr. Philippe Vial, Hôpital cantonal Fribourg, Fribourg/CH; Prof. Dr Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH

Introduction: Carpal tunnel syndrome (CTS) is a frequent pathology needing local decompression. Nerve compression is mainly due to inflammatory disease of the flexor tendons or local bony anomalies. We present a case with CTS due to localized hypertrophic neuropathy.
Case report: A 57-year-old woman presented with a history of a slowly progressive tumefaction since two years and symptoms typical for a CTS, like hyposensibility in the cutaneous region innervated by the median nerve, and pain in the hand and fore-arm during wrist flexion. EMG revealed a nerve lesion that was partially axonal in the region of the wrist. Preoperative MRI investigation showed a hypertrophy of the median nerve starting from the distal third of the forearm until to the transversal carpal ligament. Intraoperative biopsies showed a localized hypertrophic neuropathy with fusiform enlargement of the nerve. Histological analysis revealed “onion bulbs” formation of immunhistological EMA positives and S-100 negatives perineural cells. Postoperatively a quick recovery of the sensory deficits of the hand as well as complete relieve of pain was observed.
Conclusion: This is the second case in the literature describing a localized hypertrophic neuropathy of the median nerve and the first case in the literature with a favourable outcome after a carpal tunnel decompression. The aetiology of this rare neuropathy is discussed controversial in the literature. Theories discussed are either a primary neoplasm of the median nerve, either a chronic mechanical lesion due to long-term compression.

P 12

Mechanical testing of 2 different variable angle locking plates for distal radius fractures

Dr. Tom Adler, Klinik für Orthopädische Chirurgie und Traumatologie des Bewegunsapparates, Bruderholz/CH; Dr. Thomas Karl Schäfer, Fremantle Hospital, Fremantle, WA/AU; Prof. Piers Yates, Fremantle Hospital, Fremantle, WA/AU

Introduction: In recent years, the volar locking plating of distal radius fractures has become popular. Locking mechanisms have improved with the variable angle locking mechanism. The aim of the study was to evaluate the different behavior of different screw plate locking mechanisms and, furthermore, the influence on the stability in the fracture setting.
Methods: Distal radius plates Synthes VA-LCP Two-Column and Stryker VariAx were compared. The locking mechanisms were tested as cantilever bending tests as cyclic staircase loading tests in 0° and 15° screw angulation as well as relocking in 0° angulation after locking in 15° using the Zwick/Roell Z010 material testing machine. The stability in an extraarticular, dorsally comminuted fracture (AO 23.A3) with Sawbones was also compared.
Results: In the locking tests the Synthes plate showed a load to failure of 834.1 N for 0°, 500.2 N for 15°. The Stryker plate showed a load to failure of 492.2 N for 0°, 202.9 N for 15°. In the relocking test a load to failure of 372.2 N was found for the Synthes plates and 155.3 N for the Stryker plates with high significance to 0° for both plates, no significance to 15°. In all three locking mechanism tests the difference between the two plates was significant. The fracture setting showed no significant difference, but different failure mechanisms.
Conclusion: Higher screw plate angulation led to less stability. Relocking does not decrease the stability compared to 15°. Although Synthes plates were superior in the locking tests, a difference in the fracture fixation could not be found.

P 13

Healthcare costs and loss of productivity in patients with trapeziometacarpal osteoarthritis

Stefanie Hensler, Schulthess Klinik, Zurich/CH; Dr. Miriam Marks, Schulthess Klinik, Zurich/CH; Prof. Dr. Thea Vliet Vlieland, Leiden University Medical Center, Leiden/NL; Dr. Wilbert van den Hout, Leiden University Medical Center, Leiden/NL; Dr. Stephan Schindele, Schulthess Klinik, Zurich/CH; PD Dr. Laurent Audigé, Schulthess Clinic, Zürich/CH; Dr. Daniel Herren, Schulthess Klinik, Zürich/CH

Introduction: In recent years, economic evaluations become increasingly important. However, such economic evaluations in orthopedics are rare, especially for the hand. This study shows the economic aspects of surgical and conservative treatment of patients with trapeziometacarpal osteoarthritis (TMC OA) with regard to costs associated with healthcare and loss of productivity.
Methods: Prospective cohort study including patients with TMC OA who received either surgery or the conservative treatment steroid injection. Healthcare costs were measured using our clinic’s earnings in Swiss francs (CHF). Patients were assessed at baseline and 3, 6, and 12 months after the intervention. Employed patients filled out the Work Productivity and Activity Impairment Questionnaire (WPAI) to assess absenteeism, presenteeism, and overall costs due to loss of productivity.
Results: We included 161 patients, 58 of whom were in employment. Healthcare costs were CHF 10,303 in the surgery group and CHF 622 in the injection group. The total productivity loss in the surgical group increased from baseline to 3 months (50% versus 64%) but decreased significantly to 25% at 1 year ($p \leq 0.001$). Total productivity loss in the injection group was more stable over time (52% at baseline to 48% at 1 year; $p = 0.051$). Estimated total annual healthcare and productivity costs were CHF 20,210 in the surgical group. 49% of these costs were attributable to loss of productivity. In the injection group, total annual costs were CHF 6,877 with 91% being attributable to loss of productivity.
Conclusion: The estimated combined annual healthcare and productivity costs were considerably higher in the surgical group, where both types of costs almost equally contributed to the total costs. In contrast, in patients treated with injection, most of the total annual costs are attributable to loss of productivity. This highlights the need for assessing productivity costs in patients with hand disorders in order to get a comprehensive view of the costs associated with a treatment. The presented healthcare costs reflect only on the earnings of our institution, not the real costs. Therefore, a further study about cost-utility analysis of TMC OA with focus on intern and extern costs was initiated at our institution.

P 14

3D Printing of distal radius fractures. A new tangible realistic way for preoperative planning, education and patient's compliance

Dr Nicola Bizzotto, University Hospital of Verona, Verona/IT; Dr Ivan Tami, Clinica Ars Medica, Gravesano (Lugano)/CH; Dr Andrea Tami, Medartis, Basel/CH

3D printing is a new technology that uses a 3D computer representation to create solid objects. They improve understanding of anatomy and pathology by means of tactile and visual experience to complement images displayed on a computer monitor. Three-dimensional print models are already used in cranio-maxillofacial and dental surgery. We decided to test this technology creating orthopaedics models of distal radius fractures. Starting from the Computer Tomography DICOM-file, we exported the 3D-Reconstructions of the fractures in printable files. Using a commercial 3D-Printer we reproduced models 1:1, white color, with high resolution of details only after 3 hours from CT scans. The models are constructed layer by layer with the print-head spraying binder onto the segmented area working with a special resin material (ABS Plus White) with a cost ranging from 5€ to 10€. We used 3D-printed distal radius fractures to improve understanding of fracture's pattern: especially, it was easier to appreciate the yielding of the articular surface and the dislocation of the fragments. On these models we were able to simulate surgical procedures for fracture reduction and we were able to test the most suitable plate and the position and fixation, the day before surgery.These personal realistic models were also showed to the patients, improving drastically their education to refine the consent.

P 15

Sesamoid fracture of the index: a rare cause of digital nerve compression

Dr Stefania Brunetti, HFR, Fribourg/CH; Dr. Nadine Kaiser, Hopital cantonal Fribourg, Bern/CH; Dr. Philippe Vial, Hôpital cantonal Fribourg, Fribourg/CH; Prof. Dr Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH

Introduction: In the human adult hand there are frequently five sesamoid bones: two at the MCP-joint of the thumb (prevalence 99.9%), one at the IP-joint of the thumb (53%), one at the radial half of the MCP-joint of the index finger (43.4 %) and one of the ulnar side of the MCP-joint of the little finger (1.47%). Fractures of the thumb sesamoids are unusual but known injuries. In contrast, fractures of other sesamoid bones of the hand seem to be a rarity. We found only 3 case reports of fractures involving the index finger sesamoid in the current literature. We report a case of a closed fracture of the radial sesamoid of MCP-joint of the index finger followed by posttraumatic temporary digital nerve neurapraxia.
Case report: A 47-year-old male patient arrived at the ER complaining of pain at the palmar face of the MCP-joint of the right index finger and a progressive diminution of mobility after a fall on the dorsally flexed hand on day before. He also developed a radial digital nerve hypoesthesia during the first 24 hours before admission. Standard radiographs were performed and a CT scanner (Fig. 3) confirmed the plurifragmentary fracture of the radial sesamoid of the MCP-joint of the index. The injury was treated conservatively with immobilization of the hand in intrinsic plus position. Quick recovery of the sensory deficit was observed at 2 days after the injury. At 6 weeks the patient presented a pain free and complete mobility of his index, radiographically, the sesamoid bone was healed.
Discussion: Fractures of sesamoid bones are rare. They frequently occur at the MCP-joint of the thumb. The mechanism of injury is a violent hyperextension of MCP-joint, direct trauma other local repetitive microtrauma. On standard radiographs including oblique views the diagnosis can be made, when in doubt a CT scanner clarifies. The fracture is associated with local edema and hematoma leading to potential compression of the adjacent digital nerve. With conservative treatment rapid recovery of the sensory deficit and uneventful fracture healing is observed.

P 16

Management of a scapho-trapezo-trapezoidal dislocation: Case report and review of the literature

Antonino Fugazzotto/CH; Dr Darius Marti, HFR Fribourg – Hôpital Cantonal, Cressier/CH; Dr. Philippe Vial, Hôpital cantonal Fribourg, Fribourg/CH; Prof. Dr Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH

Introduction: Dislocation of the scapho- trapezo-trapezoidal joints (STT) is a rare injury of the wrist. The main cause is a high energy trauma. We present a clinical case of isolated STT dislocation caused by a low energy trauma.
Case description: A 16-year-old female patient was admitted to the emergency department with a carpal flexion injury. The patient was taking an object out of a drawer when she experienced a sudden pain in her wrist associated with radial deviation. Clinical examination showed her left wrist in pronation position with a dorsal carpal prominence. The patient was incapable of performing ulnar deviation movements. Radiographic studies revealed an increased scapho-lunate space and a cortical ring sign indicating a volar tilt of the scaphoid suspicious for a subluxation of the scaphoid. CT-scan analysis revealed a dislocation of the STT-joints. Closed reduction was performed under sedation and the wrist was immobilized in a dorsal cast splint. Control radiographs confirmed the accurate reduction of the scaphoid. One day later, the patient complained of increasing pain in her left wrist and radiographic studies revealed a recurrent dislocation of the STT-joints. Closed reduction and percutaneous transarticular scapho-trapezial Kirschner wire fixation was performed under general anesthesia. The Kirschner wire was removed after 6 weeks and physical therapy was initiated.
Result: Three months postoperatively the patient showed a complete and pain free range of motion of her wrist and thumb, and the STT-joints were stable clinically.
Conclusion: STT dislocation is a rather rare injury and the few cases described are exclusively associated with high energy trauma with mostly an axial or rotatory injury of the wrist. The described case is the first showing a dislocation of the STT-joints after a bagatelle trauma. Closed reduction and immobilization with a dorsal splint seem to be insufficient to keep the STT-joints correctly reduced. Additional transarticular K-wire fixation is required for temporary fixation until healing.

P 17

Ulnar nerve compression caused by a variant of flexor carpi ulnaris tendon

Monika Senftl, HFR Fribourg – Hôpital Cantonal, Bern/CH; Dr. Attila Güleryüz, HFR Fribourg – Hôpital Cantonal/CH; Prof. Dr Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH; Dr. Philippe Vial, Hôpital cantonal Fribourg, Fribourg/CH

Introduction: Compression neuropathy of the ulnar nerve distal to the pisiform is a well described syndrome and the great majority of these lesions show nerve compression in the Guyon's canal. However, nerve entrapment can occur also proximal to the pisiform. We describe an anatomical variant where a part of the split ulnar nerve passed in between the two parts of a split tendon of the flexor carpi ulnaris at its insertion creating a nerve compression syndrome outside the canal of Guyon.
Case description: We present a case of an ulnar nerve compression due to anatomical variants of the flexor carpi ulnaris tendon and the ulnar nerve proximal to the pisiform. Surgical exploration of the distal 4 cm of the flexor carpi ulnaris tendon revealed a split insertion at the pisiform. Dissection of the ulnar nerve revealed one fascicle divided from the major trunk and penetrating the split in the tendon from the dorsal side. The separate fascicle then rejoined the major trunk of the nerve adjacent to the pisiform. After analysis of the uncommon anatomy, the radial insertion of the tendon was detached, allowing the divided nerve to join the major trunk and the tendon was then reinserted to the main tendon of the flexor carpi ulnaris proximal to its insertion. After neurolysis and modification of the insertion of the tendon, the symptoms of the patient were completely relieved.
Discussion: Duplication of the flexor carpi ulnaris tendon insertion with entrapment of a part of the ulnar nerve is a rare anatomical variation and may be the cause of an ulnar nerve compression syndrome at the level of the wrist, mimicking a classic compression at the Guyon's tunnel. Even when rare, such an anatomical variation should be kept in mind during surgery in this area.

P 18

Complications and cancer rates in spine fusion with recombinant human bone morphogenetic protein-2 (rhBMP-2)

Dr. Julia Vavken, UniSpital Basel, Basel/CH; Dr. Alexander Mameghani, Kantonsspital Baden, Baden/CH; Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; Prof. Dr. Stefan Schären, Universitätsspital Basel, Basel/CH

Introduction: The objective of this study was to quantitatively synthesize the available best evidence for general complications, heterotopic ossification, retrograde ejaculation, cervical swelling, and cancer rates with the use of rhBMP-2 in lumbar and cervical spine fusion.
Methods: We conducted an online search for relevant controlled trials and extracted data on the abovementioned endpoints. Studies were eligible for inclusion if they reported on spinal fusion with rhBMP-2 and a minimum follow-up of 6 months. Publication bias and heterogeneity were assessed mathematically. These data were synthesized in a meta-analysis using DerSimonian-Laird random effects modeling to calculate pooled odds ratios.
Results: We identified 29 studies reporting on a total of 184,324 patients (28,815 experimental, 155,509 controls) with a mean age of 51.1 ± 1.8 years. There was a significantly higher risk of general complications with rhBMP-2 compared to iliac crest bone graft (ICBG) with an odds ratio (OR) of 1.78 (95%CI 1.20 to 2.63), (p = 0.004). The odds ratio for HO was 5.57 (95%CI 1.90 to 16.36), (p = 0.002), for RE 3.31 (95%CI 1.20 to 9.09), (p = 0.020), and for cervical swelling 4.72 (95%CI 1.42 to 15.67), (p = 0.011), all significantly favoring the rhBMP-2 group. The pooled odds ratio for new onset of tumor was 1.35 (95%CI 0.93 to 1.96), which represents no statistical difference between the groups (p = 0.111).
Conclusion: rhBMP-2 is associated with a higher rate of general complications as well as RE, HO, massive cervical tissue swelling in spine fusion. There is a slightly increased risk of new onset of tumors, however, without statistical significance.

P 19

How to reduce bilateral cervical facet joint dislocation in anterior approach – a trick to avoid anterior-posterior-anterior surgical procedures

Dr. Martin Jäger, Aarau/CH

Introduction: Cervical facet joint dislocation is a common injury of the lower cervical spine. These flexion-distraction lesions in cervical spine occur as a subluxation or unilateral/bilateral dislocation of the facet joints, which often be accompanied by direct spinal cord and nerve root injury. The presence of herniated intervertebral disc requires an anterior approach to decompress the spinal cord. Because often it is not possible to reduce facet joint dislocation while performing anterior surgery an additional posterior approach and then the fixation trough an anterior approach again is necessary. This method (supine-prone-supine) creates difficulties for surgeons because of the prolonged operation time; the need for frequent changes in patient position; and a subsequent high incidence of complications.
Materials and Methods: Based to a case we present a maneuver to use pins like joysticks in vertebral body during anterior approach to reduce dislocated facet joints in cervical spine fractures. After cervical discectomy / corpectomy we use the pins to put the vertebral body in kyphotic position following rotational motion to reduce the facet joints.
Results and Conclusion: Since we implemented this procedure we had no more to perform posterior approach in surgical treatment in the last fifteen cases of bilateral facet joint dislocation with herniated intervertebral disc in cervical trauma.

P 20

Influence of gender on patient-orientated outcomes in spine surgery

Laura Pochon/CH; Dr. Frank S. Kleinstück/CH; PD Dr. François Porchet/CH; Dr. Tamas F. Fekete/CH; Dr. Daniel Haschtmann/CH; Dr. Dezsö Jeszenszky, Schulthess Klinik/CH; PD Dr. Anne F. Mannion, Schulthess Klinik, Zürich/CH

Introduction: Few studies have examined gender differences in patient-oriented health-related quality of life before and after spine surgery. This study examined the influence of gender on baseline status and 1-year postoperative outcomes in a large series of patients undergoing surgery for different degenerative spinal disorders.
Methods: The study included 1518 patients (812 men and 706 women; mean (SD) age 61.4 ± 16. years), with 3 different pathologies (disc herniation, degenerative spondylolisthesis, or spinal stenosis), treated with specified surgical approaches. Preoperatively and 12 months postoperatively, patients completed the multidimensional Core Outcome Measures Index (COMI). Medical history, surgical details and perioperative complications were documented with the Eurospine "Spine Tango" Surgery 2006 form.
Results: Preoperatively and for all three pathologies, women had significantly ($p < 0.05$) worse COMI-scores than men, especially for the sub-domains "leg/buttock pain", "dominant pain intensity", and "general quality of life"; the change in the COMI sum score 12 months postoperatively showed no significant gender differences for any pathology ($p > 0.05$). 71.3% males and 72.9% females achieved the minimal clinically important change score (MCIC; 2.2 point reduction) for the COMI. Controlling for potential cofounders (preoperative COMI, ASA, complications, pathology), gender showed no significant association with the failure to achieve MCIC.
Conclusion: This results show that women do not differ significantly from men regarding their postoperative outcome, even though they present with a worse preoperative status. The management of a patient's condition should not differ depending on their gender, since both men and women are able to improve to a similar extent.

P 21

The spino-pelvic geometry in different types of adolescent idiopathic scoliosis

PD Dr. Mazda Farshad, Universitätsklinik Balgrist, Zürich/CH; Sabrina Catanzaro, Universitätsklinik Balgrist, Zürich/CH; Dr. Samuel Schmid, Universitätsklinik Balgrist, Zürich/CH

Background: The Lenke classification is well-established in determination of different curve types in adolescent idiopathic scoliosis (AIS) and guides selection of fusion levels. However, up to date, it neglects spino-pelvic parameters, which might be relevant for development of adjacent segment problems and compensatory mechanisms in balancing the human erect posture. The aim of this study was investigate spino-pelvic parameters in different types of AIS curves.
Material and Methods: Preoperative whole spine x-rays from one hundred patients with AIS were reviewed and the curves were classified according to Lenke. In addition, sagittal spino-pelvic parameters (Pelvic incidence, sacral slope, pelvic tilt) were measured and compared between different curve types and to normal population values.
Results: Differences of the spino-pelvic balance, as compared to normal population values, were seen in AIS Lenke curves type 5 and 6, with the main curve in the thoracolumbar or lumbar spine, with pelvic incidence of 44.2° ± 8.1 (norm 49.1°), sacral slope of 33.8° ± 6.7 (norm 41.4°) and pelvic tilt of 10.3° ± 6.5 (norm 7.7°).
Conclusion: Overall, the variance of spino-pelvic parameters in different AIS curve types was not large. However, AIS curves with main curves located in the lower spinal region, demonstrated a more verticalized sacrum. It remains unknown, whether the verticalization of the sacrum might be a compensatory mechanism to keep the whole spine balanced and if it reverses with correction of the scoliosis.

P 22

Annulus fibrosus Repair with a Genipin-enhanced Fibrin based Hydrogel and silk membrane-fleece

PD Dr. Lorin Michael Benneker, Inselspital Bern, Bern/CH; Dr. Daniela Frauchiger, Bern/CH; Prof. Dr. Benjamin Gantenbein/CH

Introduction: Low back pain is mainly caused by trauma causing intervertebral disc (IVD) herniation and / or IVD degeneration. Despite promising approaches for nucleus pulposus repair so far no treatment or repair is available for annulus fibrosus (AF) injuries. Here we aimed to develop a new method to seal and repair AF injuries by using a silk fleece composite and a genipin-enhanced hydrogel.
Methods: Bovine (b) IVDs were harvested under aseptic conditions and kept under free swelling conditions for 24h in high-glucose DMEM containing 5% bovine serum for equilibration. Then a reproducible circular 2 mm defect was formed in the AF with a biopsy punch (Polymed Medical Center, Switzerland). The defect was filled with human-derived fibrin gel (Baxter Tissucol Kit, Switzerland) enhanced with the cross linker genipin (Wako Chemicals GmbH, Germany). In order to seal the defect site a silk membrane-fleece composite (Spintec Engineering GmbH, Germany) was used. Thereby the membrane side was facing outwards to ensure proper sealing. bIVDs were subsequently cultured in vitro for 14 days either under complex loading in a custom-built bioreactor under physiological conditions (0.2MPa load and ±2° torsion at 0.2 Hz for 8h/day) or static diurnal load of 0.2MPa for 8h/day. At the end of culture discs were assessed

for seal failure, disc height, metabolic activity, cell death by necrosis (LDH assay), apoptosis (caspase 3/7 activity), DNA and glycosaminoglycan content and gene expression of IVD anabolic and catabolic genes.
Results: The silk composite was able to withstand the applied forces during the 14 days of culture and maintained its position. Despite showing slightly lower cell activity DNA and GAG content of repaired discs were in the range of the control. Furthermore LDH resulted in similar values compared to control discs. Height loss in repaired discs was in the same range as for static diurnal loaded control samples. For dynamically loaded samples the decrease was comparable to the injured, unrepaired discs.
Conclusion: Genipin reinforced fibringel is a promising approach to close AF defects as tested by two degree of freedom loading. In further experiments cytocompatibility of genipin and regenerative properties have to be investigated.

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P 23

Union rate and complications in spine fusion with recombinant human bone morphogenetic protein-7

Dr. Julia Vavken, UniSpital Basel, Basel/CH; Dr. Alexander Mameghani, Kantonsspital Baden, Baden/CH; Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; Prof. Dr. Stefan Schären, Universitätsspital Basel, Basel/CH

Introduction: The objective of this meta-analysis was to evaluate the current best evidence to assess effectiveness and safety of rhBMP-7 as a biological stimulant in spine fusion.
Methods: Studies were included if they reported on outcomes after spine fusion with rhBMP-7. Data were synthesized using Mantel-Haenzel pooled risk ratios (RR) with 95% confidence intervals (95%CI). Main endpoints were union rate, overall complications, postoperative back and leg pain, revision rates and new onset cancer.
Results: Our search produced 285 studies, six of which were eligible for inclusion. These studies report on a total of 442 patients (328 experimental, 114 controls) with a mean age of 59 ± 11 years. Our analysis showed no statistically significant differences in union rates (RR 0.97, 95%CI 0.84 to 1.11, p = 0.247), overall complications (RR 0.92, 95%CI 0.71 to 1.20, p = 0.545), postoperative back and leg pain (RR 1.03, 95%CI 0.48 to 2.19, p = 0.941) or in revision rate (RR 0.81, 95%CI 0.47 to 1.40, p = 0.449). There was a mathematical indicator of increased tumor rates, but with one single case, the clinical meaningfulness of this finding is questionable.
Conclusion: We were not able to find data in support of the use of rhBMP-7 for spine fusion. On the plus side, we found no evidence for increased complication or revision rates with rhBMP-7. On the other hand we also found no evidence in support of improved union rates.

P 24

Radiographic analysis of entry and aiming points on lateral pelvic views for optimal sacroiliac joint fixation using sacroiliac screws

Julien Jost, Inselspital Bern/CH; Dr. Jennifer Larissa Cullmann, Inselspital Bern/CH; PD Dr. Emin Aghayev, University of Bern, Medical Faculty/CH; Prof. Dr. Marius Johann Keel, Inselspital Bern, Bern/CH; PD Dr. Lorin Michael Benneker, Inselspital Bern, Bern/CH; Dr. Johannes Dominik Bastian, Inselspital Bern, Bern/CH

Introduction: The study assessed entry and aiming point (EP, AP) positions for sacroiliac joint fixation on sagittal pelvic views with reference to patient demographics and sacral morphology.
Methods: EP and AP were defined in 200 CTs of normal pelves as locations of screw heads or tips at crossings of lateral innominate bones' cortices or sacral midlines, respectively, with centres of optimal pathways in horizontal (axial) and vertical (coronal) planes. A coordinate system was introduced on the sagittal planes with the zero-point in the center of the posterior cortex of S1 vertebral body (x-axis parallel to upper S1 endplate) to transfer entry and aiming point positions to lateral pelvic views. Influence of patient age, gender, side, pelvic incidence angle, transversal curvature angle (TCA), pelvic incidence length-index (PIL-index), and unilateral sacral width-index (USW-index) on horizontal and vertical distances of EP and AP from the zero-point was assessed in a multivariate analysis.
Results: Mean horizontal distance for EP and AP were 14% (±24) and –53% (±7) and mean vertical distance for EP and AP were –41 (±14)% and 11% (±7). PIA, PIL-index, and USW-index significantly influenced EP and AP. Additionally, age, gender, and TCA significantly influenced EP.
Conclusion: The presented approach transferred optimal EP and AP from CT data to a single sagittal plane that can be used for intraoperative fluoroscopy and facilitates optimal screw fixation of sacroiliac joints. The study results and the approach may help in improving screw fixation, decreasing operating and fluoroscopy times as well as radiation exposure.

P 25

Cervical spine dimensions evolution in Switzerland

Prof. Dr Constantin Schizas, Clinique Cecil, Lausanne/CH; Dr Arnaud Monier, CHUV, Lausanne/CH; Dr Patrick Omoumi, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne/CH; Stéphanie Schizas, Gymnase de Burrier, la Tour de Peilz/CH; Dr Fabio Becce, Centre hospitalier universitaire de Lausanne, Lausanne/CH

Introduction: Previous research on spinal canal dimensions in western Switzerland showed that contrary to what would be expected, younger generation subjects have smaller lumbar canals measured at pedicle level compared to older patients despite documented increase in average height secondary to better living conditions. We aimed to study the secular changes of cervical spinal canal dimensions in the same geographical region during the same chronological period. In addition we aimed to verify the results of previous research on the lumbar spine in this part of the country.
Material and Methods: Cervical spine CTs from total of 254 patients were included in this study. From those 144 were born between 1940–49 and 109 between 1970–79. CTs were performed as part of the spine clearing procedure on admission following trauma (n = 135) or while investigating neurological symptoms (CT angiography) (n = 119). Cross sectional area (CSA) was digitally measured at pedicle level from C0 to C7 as well as AP diameter at C3, C5 and C7 levels. In addition lumbar spine CSA were measured in trauma or abdominal CTs which were available for 119 patients from the above mentioned cervical spine group.
Results: On average CSA were numerically smaller in the younger group of patients as far as both the cervical and lumbar spine were concerned. This difference was highly statistically significant for L1, L2 and L3 while it was statistically significant for L4. Subgroup analysis showed that younger, CT angiography patients had statistically smaller CSA values at C1, C4 and L5 levels. In the trauma subgroup younger patients showed a highly statistical significance at L1, L2 and L3 levels and a statistical significance at L4 level with smaller CSA values than older trauma patients. In the CT angiography population the younger group had statistically smaller CSA values at C1, C4 and L5 levels. Analysis according to gender in each subgroup showed a similar trend.
Discussion: Younger generation subjects have smaller canals at pedicle level although this was more pronounced at lumbar level. Possible explanation could be maternal smoking and older maternal age in the 70s. The lesser difference observed in the cervical spine could be due to the later closure of the neurocentral synchondrosis in the cervical and sacral region. Further studies in different populations would be of great interest in confirming this trend.

P 26

Reconstruction of femoral head impaction injuries using osteochondral shell autografts harvested from the head-neck junction

Dr. Johannes Dominik Bastian, Inselspital Bern, Bern/CH; Dr. Jennifer Larissa Cullmann, Inselspital Bern/CH; Dr. Salvatore Tomagra, Inselspital Bern/CH; Prof. Dr. Harald Marcel Bonel, Inselspital Bern/CH; Prof. Dr. Marius Johann Keel, Inselspital Bern, Bern/CH

Introduction: Traumatic dislocation of the hip might be complicated by impaction injuries to the femoral head. This study reports the outcome after a minimum follow up (FU) of two years in a consecutive series treated with transfer of osteochondral shell autografts in hips (TOSAH) from the head-neck junction into the defect using surgical hip dislocation.
Methods: Between 06/2007 and 03/2014 twelve patients (median age: 38yrs, range: 17–53; median Injury Severity Score: 13, range: 9–14) sustained a traumatic posterior hip dislocation in combination with acetabular and/or Pipkin fractures and were inter alia treated using TOSAH. Conversion to total hip replacement (THR) during FU was noted as failure. Patients with preserved hips and a minimum FU of two years were included for clinical evaluation using the Merle-d'Aubigné Score and radiographic assessment for occurrence of osteoarthritis (OA), avascular necrosis (AVN) and/or heterotopic ossifications (HO).

Results: In four patients conversion to THR was performed at eleven, twelve, 28 and 44 months postoperatively. Out of eight patients with preserved hips, five (median age: 44 yrs, range 20–53) passed a follow up of two years (median FU: 26 mths, 24–62) and presented with a median Merle-d'Aubigné Score of 16 points (range: 14–18), no signs for OA or AVN but HO (Brooker grade 1 in two, Brooker grade 2 in one).
Conclusion: The presented technique used as a salvage procedure for severely injured hip joints showed the potential to delay conversion to THR up to almost four years and to preserve the hip joint at midterm with satisfying clinical and radiological outcome.

P 27

Avulsion fracture of the apophysis of the ischial tuberosity: The role of quadratus femoris

Monika Senftl, HFR Fribourg – Hôpital Cantonal, Bern/CH; Dr Darius Marti, HFR Fribourg – Hôpital Cantonal, Cressier/CH; Dr. Ines Raabe, HFR Fribourg – Hôpital Cantonal/CH; Prof. Dr Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH

Introduction: Avulsion fracture and distal displacement of the apophysis of the ischial tuberosity is a rare injury and generally considered as a pure avulsion of the ischiocrural muscles. Injury mechanism is usually a sudden and violent eccentric muscle contraction of the hamstrings when the knee is in an outstretched position and the hip flexed. According to the amount of displacement operative treatment can be indicated. We present two patients with a partial avulsion of the ischial tuberosity with mainly lateral displacement of the fragment being interpreted as avulsion of the quadratus femoris muscle with only partial involvement of the hamstrings.
Case description: We present two patients with apophyseal avulsion of the ischial tuberosity associated with quadratus femoris muscle avulsion. A 13-year-old boy sustained a direct injury to the left buttock following a fall down the stairs and a 13-year-old girl injured by an eccentric load during a squat. After the injury both patients had an antalgic gait due to pain in the inferior gluteal area with radiation to the proximal posterior thigh. Pain was aggravated by sitting and squatting. Radiography of the pelvis showed an avulsion of the ischial tuberosity without an important distal displacement of the apophyseal fragment. MRI examination demonstrated lateral displacement of the osseous fragment to which the quadratus femoris was attached. The treatment was conservative and consisted of 6 weeks of partial weight bearing followed by progressive loading and mobilization.
Conclusion: In both cases radiographic analysis revealed a partial avulsion of the ischial tuberosity without concomitant distal, but lateral displacement of the avulsed fragment. Thus, the lesion involves mainly the quadratus femoris origin and less or only partially the origins of the semimembranosus, semitendinosus or biceps muscles. MRI analysis can be useful to clarify the diagnosis. In such cases conservative treatment is indicated without the danger of the development of an ischial pseutotumor leading to painful and oblique sitting position.

P 28

Late onset imminent femoral fatigue fracture associated with intraoperative cement extrusion as a rare cause of thigh pain after total hip replacement: A report of three cases

Dr. Alexander Antoniadis, Uniklinik Balgrist, Zürich/CH; PD Dr. Patrick Zingg, Uniklinik Balgrist, Zürich/CH; Prof. Dr. Claudio Dora, Uniklinik Balgrist, Zürich/CH

Introduction: Cement extrusions on the femoral side after total hip replacement can occur in approximately 0.3% of cemented primary total hip replacements. Not recognised until a postoperative x-ray is performed, the willingness to dismiss and treat these extrusions conservatively is high.
Methods: We report on three patients presenting with sudden onset of thigh pain associated with weight bearing inability after a two to fifteen month period of uneventful healthy recovery from primary cemented total hip replacement. On immediate postoperative x-rays occult cement extrusion in the posterolateral circumference of the femoral component tip were present. X-rays and CT scans showed unchanged cortical circumferences with cortical defects filled with cement but no fracture sign. Scintigraphy revealed late increased uptake at the extrusion height. With the hypothesis of imminent femoral fatigue fracture, all patients underwent revision surgery. The defect sites were surgically exposed, thoroughly cleaned of cement, filled with iliac crest bone graft and stabilised with tension band plating.
Results: This procedure resulted in fully recovered asymptomatic patients at six weeks and after a mean follow-up period of 48 months, as demonstrated by their pain level and tolerance of full weight bearing.
Conclusion: These cases lead us 1) to adopt a low threshold for immediate revision when occult cement extrusion is recognised near the tip of a cemented stem on postoperative films, 2) to adopt a low threshold for surgical revision when, in the presence of cement extrusion, thigh pain is a complaint and 3) favour tension band plating and bone grafting over more complex implant revisions since a fast recovery was achieved in these patients.

P 29

Direct anterior approach in supine position – comparison of two techniques: with and without legholder

Dr. Kersten Berndt, University hospital Balgrist, Zürich/CH; PD Dr. Patrick Zingg, Uniklinik Balgrist, Zürich/CH; Dr. Daniel Müller, University hospital Balgrist, Zürich/CH; Prof. Dr. Claudio Dora, Uniklinik Balgrist, Zürich/CH

Introduction: One important step in total hip replacement (THR) using the direct anterior approach (DAA) is the appropriate exposition to the femur allowing strait access to the femoral canal. Three techniques have been described in order to ease this step. Since July 2004 the DAA was adopted in our institution following the Innsbruck technique (IT: supine position; without leg holder or traction table) overlapped by the AMIS technique (AT: supine position; legholder) starting 2005. The aim of the present study was to compare both techniques in terms of complications, mid-term clinical and radiological results.
Methods: All patients with THR implanted with DAA between July 2004 and April 2006 were retrospectively included and contacted after a minimum follow-up (FU) of 5 years. Trident/Accolade TMZF; Stryker Orthopaedics was used for the IT and Versafit®-CC /Quadra®-H; Medacta was implanted with AT. A 28 mm CoCr ball and a highly cross-linked polyethylene were used for both techniques. Complications were extracted from patient charts and cumulative 5-year implant-survival was estimated using Kaplan-Meier analysis. Subjective hip value (SHV), WOMAC and Harris hip score (HHS) were analyzed before surgery and at FU. Cup position was determined on the postoperative x-rays and radioluciency around the stem and the cup were assessed in the x-rays at FU.
Results: IT was performed 151 times in 142 patients and AT 150 times in 150 patients. There were no significant differences in terms of complications, failed intentions to treat and survival of implants with IT and AT: metaphyseal fractures (5 vs. 2), wound healing disorders (2 vs. 0), hematomas (1 vs. 2) and early infections (1 vs. 0), failed intentions to treat (11 vs. 4) and implant-survival after 5 years (96% vs. 97.2%) were equivalent ($p > 0.05$). Clinical outcome was similar in both groups (SHV, WOMAC score and HHS; $p > 0.05$). 59% vs. 63% of the cups were implanted within the save zone of Lewinneck with IT and AT, respectively ($p > 0.05$). Radiolucency occurred in the gruen zone 1 in 3.3 vs. 33% and gruen zone 7 in 0 vs. 18.6% in IT and AT, respectively ($p < 0.001$).
Conclusions: Trident/Accolade (IT) and Versafit/Quadra (AT) are both safe implants and techniques with no significant differences regarding intra- and perioperative complications, 5-year implant-survival and clinical outcome. The higher rate of radiolucency in the gruen zones 1 and 7 in the Quadra stem is most probably due to the implant design.

P 30

Intraneural ganglion cyst of the hip as a rare cause of L5-radiculopathy

Dr. Tim Benjamin Briem, Schulthess Clinic, Zurich, Switzerland, Zürich/CH; Dr. Gerard Haemmerle, Schulthess Clinic, Zurich, Switzerland, Zurich/CH; Dr. Inès Kramers-de Quervain, Schulthess Clinic, Zurich, Switzerland, Zurich/CH; PD Dr. Michael Leunig, Schulthess Klinik, Zurich/CH

Study Design: Case Report Objective: We report a rare case of a dorsal intraneural ganglion cyst of the left hip causing L5-radiculopathy in a 48-year-old female.
Summary of Background Data: Radiculopathy normally occurs as a cause of disc herniation or foraminal stenosis in the spine. Up to now there are only a few reported cases of symptomatic intraneural ganglion cysts as a result of posterior ganglion of the hip.
Methods: A 48-year-old female reported a 12-month history of intermittent pain in the groin and left buttock, which was aggravated under physical stress. Consecutively she developed radiating pain in her left leg. MRI scans of the lumbar spine and the left hip showed a

small labral tear and a foraminal stenosis L5/S1 on the left side. Therefore she had been treated as a case of degenerative lumbar spine syndrome, but conservative treatment was ineffective. Infiltration of the nerve root L5 showed good, but no persistent response. The following MRI of the pelvis revealed a 10 cm long cystic ganglion, which took its filiform origin from the dorsal aspect of the hip joint continuing pearl-necklace like along the M. obturator internus. Using the N. ischiadicus as a guiding structure the ganglion extends through the foramen ischiadicum majus towards the nerve root L5 causing a severe nerval compression. One possible therapeutical approach would be a laparoscopic decompression of the nerve root not addressing the presumably intraarticular origin of the pathology. In order to prevent a possible relapse we favour an open resection of the ganglion combined with a labral refixation via surgical hip luxation. Clinical results will be reported as soon as surgery is performed.
Conclusion: In this case the patient presented a trias of pain in the groin, the hip and radiculopathy. As sciatica and radiculopathy are entities with high incidence clinical findings were misinterpreted as independent from each other delaying correct treatment. This case report highlights the need for meticulous clinical examination and critical interpretation of image-guided diagnostics. Furthermore there seems to be a common underlying mechanism of propagation as there is at least one similar documented case with affection of the lumbar plexus mimicking sciatica.

P 31

Optimal component placement in total hip arthroplasty according to combined Safe-Zone (cSafe-Zone) with impaction-controlled stem-first technique

PD Dr. Karl-Heinz Widmer, Schaffhausen/CH

Introduction: Dislocation due to suboptimal cup positioning is a devastating early complication in total hip arthroplasty. Malpositioning can result also in other mechanical complications like subluxation, edge loading, increased debris, surface damage or squeaking in ceramic-on-ceramic hips. Preventing these complications in younger and more active patients is of paramount interest since optimized component orientation is an important determinant to reduce such risks and to further improve longevity. This study reports on two new instruments which make the manual placement of both components within the correct combined safe-zone (cSafe-Zone) an easy task for the surgeon.
Material and Methods: More than 900 minimal-invasive total hip arthroplasties (MIS-THA) have been performed between 2007 and 2014 in our institution using the minimal-invasive direct anterior approach (DAA) on an orthopedic table with foot holder. Cups were implanted applying the “stem-first” surgical technique i.e. the prosthetic stem dictates the orientation of the socket. A system-specific trial head and a modified cup impactor was used to finally seat the original acetabular socket during trial stem reduction and to fully control the optimal orientation of the cup during impaction. This system intraoperatively drives both components to their optimal relative positions according to the combined version and the combined safe-zone concept.
Results: Both new instruments, femoral trial head as well as the modified cup impactor, provide an easy way to manually control the optimal placement of the acetabular socket during impaction intraoperatively. The combined safe-zone is clearly indicated and the inverse interrelationship of stem and cup anteversion is ideally reflected by this simple mechanical system. In patients operated on with the “stem-first” technique the components were placed in the new cSafe-Zone in 94% of the cases and no squeaking or prosthetic impingement did occur in any of these patients. One early dislocation did occur and was treated by closed reduction.
Conclusion: Stem-first technique using trial head-controlled impaction with a modified cup impactor is ideally suited for the minimal-invasive direct anterior approach in total hip arthroplasty to control the placement of both prosthetic components. It assists the surgeon in aligning the cup and the stem according to the cSafe-Zone in order to get the intended range of movement.

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Head reduction osteotomy with additional containment surgery improves sphericity and containment and reduces pain in Legg-Calvé-Perthes disease

Dr. Simon Damian Steppacher, Inselspital, University of Bern, Bern/CH; Dr. Helen Anwander, Inselspital Bern, Bern/CH; Dr. Corinne Andrea Zurmühle, Inselspital, University of Bern., Bern/CH; Prof. Dr. Moritz Tannast, Inselspital, University of Bern., Bern/CH; Dr. Theddy Slongo, Inselspital Bern, Bern/CH; Prof. Dr. med. Klaus-Arno Siebenrock, Inselspital, University of Bern, Bern/CH

Severe femoral head deformities in the frontal plane such as hips with Legg-Calvé-Perthes disease (LCPD) are not contained by the acetabulum and result in hinged abduction and impingement. These rare deformities cannot be addressed by resection, which would endanger head vascularity. Femoral head reduction osteotomy allows for reshaping of the femoral head with the goal of improving head sphericity, containment, and hip function. Among hips with severe asphericity of the femoral head, does femoral head reduction osteotomy result in (1) improved head sphericity and containment; (2) pain relief and improved hip function; and (3) subsequent reoperations or complications? Over a 10-year period, we performed femoral head reduction osteotomies in 11 patients (11 hips) with severe head asphericities. Five of 11 hips had concomitant acetabular containment surgery including two triple osteotomies, two periacetabular osteotomies (PAOs), and one Colonna procedure. Patients were reviewed at a mean of 5 years (range, 1–10 years). We obtained the sphericity index to assess head sphericity. Containment was assessed evaluating the proportion of patients with an intact Shenton’s line, the extrusion index, and the lateral center-edge (LCE) angle. Merle d’Aubigne-Postel score and range of motion were assessed to measure pain and function. Complications and reoperations were identified by chart review. At latest followup, femoral head sphericity, extrusion index, and LCE angle were improved compared with preoperatively. The proportion of an intact Shenton’s line and the overall Merle d’Aubigne-Postel score remained unchanged at latest followup. The Merle d’Aubigne-Postel pain subscore improved. Range of motion was not observed to have improved. Subsequent surgery was performed in five of 11 hips to improve containment after a mean interval of 2.3 years (range, 0.2–7.5 years). Of those, two hips had triple osteotomy, one hip a combined triple and valgus intertrochanteric osteotomy, one hip an intertrochanteric varus osteotomy, and one hip a PAO with a separate valgus intertrochanteric osteotomy. No avascular necrosis of the femoral head occurred. Femoral head reduction osteotomy can improve femoral head sphericity. Improved head containment in these hips with an often dysplastic acetabulum requires additional acetabular containment surgery, ideally performed concomitantly. This can result in reduced pain and avascular necrosis seems to be rare.

P 33

How sensitive and specific is 1.5 Tesla MRI for diagnosing injuries in patients with knee dislocation?

Emma Derby, Kantonsspital Baselland, Bruderholz/CH; Dr. Julia Imrecke, Diakoniekrankenhaus Friederikenstift gGmbH, Hannover/DE; Felix Amsler, Amsler Consulting, Basel/CH; Dr. Johann Henckel, Institute of Orthopaedics and Musculoskeletal Science, University College London and the Royal National Orthopaedic Hospital, Stanmore/GB; PD Dr. Michael Hirschmann, Kantonsspital Baselland, Bruderholz/CH

Introduction: The purpose of our study was to assess the sensitivity and specificity of 1.5T magnetic resonance imaging (MRI) in diagnosing and identifying the specific injury pattern in patients with knee dislocation. Our hypothesis was that the sensitivity and specificity is low in patients with posterolateral corner injury and/or PCL tear.
Methods: A retrospective study was performed on 38 patients (m:f = 29:9, mean age ± SD 34.3 ± 14.0) with traumatic knee dislocation, who underwent 1.5T MRI prior to surgery.
Methode: MRI scans were reported by a musculoskeletal radiologist and the presence and type of tears to ligaments, tendons and meniscus were recorded. Comparison was made with the intraoperative findings from the surgical records using the same reporting scheme. The agreement between MRI and surgical findings was assessed using kappa statistics and the sensitivity and specificity were calculated.
Results: In patients with knee dislocation, MRI was found to have high sensitivity in the diagnosis of tears in the cruciate and collateral ligaments (97–100%); the specificity however was lower (50–67%). The diagnosis of injury to the rest of the posterolateral corner showed

low sensitivity (25–38%) but a high specificity (94–97%). The diagnosis of meniscal injury showed low sensitivity (36–56%) and moderate specificity (69–83%).
Conclusion: MRI is a sensitive measure of cruciate and collateral ligament injury in acute knee dislocation, but it does not reliably diagnose injury to the remainder of the posterolateral corner or meniscus and therefore a higher index of suspicion is required during arthroscopy to prevent misdiagnosis which could affect long term clinical outcome.

P 34

How to evaluate bone tunnel widening after ACL reconstruction – a critical review

PD Dr. Michael Hirschmann, Kantonsspital Baselland, Bruderholz/CH; Dr. Jonathan Koch, Meir Medical Center, Kfar Saba/IL; Dr. Arjen de Beus, Universitätsspital Basel, Basel/CH; Dr. Anna Hirschmann, Universitätsspital Basel, Basel/CH

Introduction: A reliable radiological assessment of patients after anterior cruciate ligament (ACL) reconstruction is important from clinical but also research perspectives. A variety of different measurement methods using x-rays, MRI or CT evaluating bone tunnel enlargement have been described. With this review, we endeavor to compare the different imaging modalities and methods being available for assessment of patients after ACL reconstruction and provide a detailed evidence-based literature overwiew, which is helpful to ACL surgeons and musculoskeletal radiologists.
Methode: We performed a PubMed search from 1970 to November 2014 using the terms "ACL reconstruction" and "tunnel" and "imaging" or "CT" or "MRI" or "radiographs". Literature search including the aforementioned search criteria identified 537 studies for potential inclusion; for all abstracts and fulltext were reviewed. 480 studies were excluded from this review, as these did not report specific radiological measurement methods. Excluded were also all 26 articles in which an identical measurement method to assess tunnel widening was used as reported in a previous study. All landmark studies reporting different imaging modalities and methods of bone tunnel measurement were selected (n = 31).
Results: Most of the authors used CT images, mainly on 2D views, for evaluating bone tunnel widening after ACL reconstruction. CT images promise a more accurate assessment of the size and shape of the tunnel walls. The tunnel walls were evaluated in 2D or 3D translucent images. Most authors assessed the CSA of the tunnels on axial CT scans perpendicular to the tunnel axis. The widest tunnel diameter was noted at one to eight different levels in relation to the joint. Percentagess of the absolute values to the original drill bit size were calculated. On MRI most authors assessed the CSA of the tunnels perpendicular to the tunnel axis. The widest tunnel diameter was noted at different levels in relation to the joint. Percentages of the absolute values to the original drill bit size were calculated.
Conclusion: CT imaging should be considered as gold standard assessing tunnel widening. Measurements in CT images should be performed in 3D using a specialized software allowing for calculating the tunnel volume. If no such software is available the CSA should be assessed perpendicular to the tunnel axis. At least one measurement should be performed at the tunnel entrance, exit and midpoint of the tunnel.

P 35

Clinical and radiographic predictors of acute compartment syndrome in tibial plateau fractures

Dr Axel Gamulin, HUG, Genève/CH; PD Dr. Anne Lubbeke Wolff, Hôpitaux Universitaires de Genève, Genève/CH; Dr Patrick Belinga/CM; Prof. Dr Pierre J. Hoffmeyer, Hôpitaux Universitaires de Genève/CH; Dr Gregory Cunningham, Hôpitaux Universitaires de Genève, Genève/CH

Introduction: the aim of this study was to retrospectively evaluate the relationship between epidemiological, clinical and radiographic factors of patients with tibial plateau fractures and the development of acute compartment syndrome.
Methods: 265 adult patients sustaining 269 intra-articular tibial plateau fractures between January 2005 and December 2009 were included in this retrospective cohort study. The outcome measure was acute compartment syndrome, which was clinically diagnosed. Patient-related (age, sex), fracture-related (mechanism of injury, closed vs. open fracture) and radiological parameters (Schatzker and AO/OTA classifications, presence or absence of a noncontiguous tibial shaft or pilon fracture or knee dislocation, tibial widening ratio, femoral displacement ratio, anatomical axis displacement direction, anatomical axis angle) were evaluated regarding their potential association with acute compartment syndrome.
Results: overall, acute compartment syndrome occurred in 28 (10.4%) of 269 tibial plateau fractures. Four patients presented bilateral tibial plateau fractures; of them, 2 had unilateral, but none had bilateral acute compartment syndrome. Univariate analysis showed that younger age ($p = 0.018$), male sex ($p = 0.008$), open fracture ($p = 0.021$), noncontiguous tibia fracture or knee dislocation ($p = 0.001$), higher Schatzker grade (IV-V-VI; $p < 0.001$), higher AO/OTA classification (type 41-C; $p < 0.001$), and higher tibial widening ratio ($p = 0.026$) were all associated with an increased rate of acute compartment syndrome. High-energy trauma, higher femoral displacement ratio, anatomical axis displacement direction and higher anatomical axis angle were not associated with acute compartment syndrome. In multivariable regression analysis, the presence of a noncontiguous tibia fracture or knee dislocation ($p = 0.002$), and a higher AO/OTA classification ($p = 0.007$) remained statistically significantly associated with the development of acute compartment syndrome.
Conclusion: Two parameters related to the occurrence of acute compartment syndrome have been highlighted in this study. They may be especially useful when clinical findings are difficult to assess (doubtful clinical signs, obtunded, sedated or intubated patients). However, larger studies are mandatory to confirm and refine the prediction of compartment syndrome occurrence.

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Knee extensor muscle weakness after knee surgery: type of surgery and contributing factors

Julia F. Item-Glatthorn, Schulthess Clinic Zuerich, Zürich/CH; Dr. Nicola C. Casartelli, Schulthess Klinik, Zürich/CH; PD Dr. Gian M. Salzmann, Schulthess Klinik, Zürich/CH; Dr. Nicola A. Maffiuletti, Schulthess Klinik, Zürich/CH

Introduction: Anterior cruciate ligament (ACL) reconstruction, articular cartilage repair (ACR), and arthroscopic partial meniscectomy (APM) are amongst the more common surgical procedures for the knee joint. The aims of this study were (1) to compare knee extensor muscle strength deficits (muscle weakness) between ACL, ACR and APM patients at short-term follow-up, and (2) to investigate the contribution of neuromuscular and surgical parameters to muscle weakness.
Methods: Fifteen ACL patients, 15 ACR patients, and 15 APM patients with a mean age of 36 years were evaluated 6 months after surgery. Knee extensor muscles were assessed bilaterally for strength (maximal isometric torque), activation (twitch interpolation technique), contractility (electrically-evoked torque), and muscle mass (vastus lateralis thickness by means of B-mode ultrasound). Surgery time was also quantified. Neuromuscular deficits were quantified as the average of within-subject asymmetries (involved vs. uninvolved side) and between-subject differences (involved side vs. uninvolved side of APM patients). Multiple linear regression analysis was used to evaluate the contribution of the different variables to muscle weakness.
Results: ACL, ACR and APM patients showed deficits of 28%, 27% and 5% for strength, 6%, 7%, and 0% for activation, 13%, 16%, and 3% for contractility, and 8%, 6%, and 0% for muscle mass, respectively. According to the regression analysis, the contribution of surgery time (ST), activation (A), contractility (C) and muscle mass (M) deficits to muscle weakness is as follows: weakness = 3.2 + 0.8*A + 0.5*M + 0.4*C + 0.1*ST.
Conclusion: ACL and ACR patients, but not APM patients, demonstrated significant knee extensor muscle weakness 6 months after knee surgery. Such muscle weakness was primarily explained by neuromuscular activation deficits (i.e., arthrogenic muscle inhibition), while structural muscle characteristics (e.g., atrophy) and surgery time contributed less. The focus on knee extensor muscle strengthening should be increased early after ACL and ACR surgery (but probably also before surgery), especially by means of strategies aimed at reducing arthrogenic muscle inhibition, e.g., neuromuscular electrical stimulation.

P 37

Destructive chondrolysis following intraarticular application of Lavasorb (Polihexanid) for treatment of knee empyema

Dr. Marco M. Schneider, Schulthess Klinik, Zurich/CH; Dr. Laurent P. Harder, Schulthess Klinik, Zürich/CH; Dr. Stefan Preiss, Schulthess Klinik, Zürich/CH; Dr. Valentino Bruhin, Schulthess Klinik, Zürich/CH; PD Dr. Gian M. Salzmann, Schulthess Klinik, Zürich/CH

Introduction: Septic arthritis after anterior cruciate ligament (ACL) reconstruction represents a rare but serious complication. Management usually consists of repeated arthroscopic lavages of the knee joint in combination with the antibiotics to treat the infection. The use of antiseptics in this context is not recommended.
Case: A 26 year old, active male patient underwent arthroscopic anterior cruciate ligament reconstruction with semitendinosus and gracilis tendon graft in double bundle technique and meniscus repair in an outward hospital. 10 days after the surgery the patient had a single arthroscopic lavage of the knee joint due to an infection with Staphylococcus caprea followed by an intraarticular 24 hour irrigation with Lavasorb (Polihexanid) and a 6-week treatment with antibiotics. One year after the infection the patient presented at our clinic. The clinical outcome (constant limping, restricted range of motion with E/F 0-30-110°, recurrent pain after weight bearing, periarticular swelling, varus deformity) and radiological findings were devastating. X-ray and MRI revealed a post infectious condition with an advanced chondrolysis of the medial and lateral compartiment, explaining the patient's complaints. The clinical examination and blood analysis did not indicate an ongoing or acute infection.
Treatment: Despite the normal blood examination we decided to perform an arthroscopy with extensive debridement, harvesting of microbiological samples and removal of all foreign materials (ACL transplant, EndoButton, interference screw, insufficient FastFix). The intraoperative findings confirmed the radiographs and showed a massive chondrolysis. An antibiotic treatment was not recommended by the infectiologists. 6 weeks after the intervention an improvement in the range of motion (E/F 0-5-120°) as well as a reduction in pain was noted. An instability of the knee joint was not described. The microbiological samples showed no bacterial growth.
Discussion: Septic arthritis of the knee joint demands immediate treatment. Literature suggests repeated athroscopic lavages in combination with an antibiotic therapy. The use of antiseptics such as Lavasorb (Polihexanid) for the treatment of infected knee joints is contraindicated due to the triggered chondrolysis. We want to emphasize that antiseptic fluids should not be part of any irrigation solution while treating intraarticular infections.

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Knee, muscle and physical function of patients six months after partial vs. total knee arthroplasty: some preliminary results

Vanessa Wellauer, Schulthess Klinik, Zürich/CH; Julia F. Item-Glatthorn, Schulthess Clinic Zuerich, Zürich/CH; PD Dr. Fabian von Knoch, Privatklinik Bethanien/CH; Dr. Nicola A. Maffiuletti, Schulthess Klinik, Zürich/CH

Introduction: The popularity of partial knee arthroplasty (PKA) surgery has increased over the last few years. Compared to total knee arthroplasty (TKA), PKA preserves the anatomical structures of the knee and may therefore result in better functional outcomes after surgery. Besides patient-reported outcomes, it is fundamental to also objectively characterize the functional recovery of patients after PKA. Therefore, the aim of this study was to evaluate subjective and objective outcomes of knee, muscle and physical function of PKA patients six months after surgery compared to TKA patients and healthy controls.
Methods: A total of 18 PKA patients (mean age ± SD: 61 ± 9 years) and 18 matched TKA patients (63 ± 5 years) were evaluated six months after surgery; 18 matched healthy controls were also tested (67 ± 3 years). Patient–reported knee function was assessed using the Western Ontario and McMaster osteoarthritis index (WOMAC) with subscales of pain, function, and stiffness. Quality of life was evaluated with the EuroQol (EQ-5D) scale. Objective outcomes of muscle and physical function were maximal isometric strength of the knee extensors, and spatiotemporal gait parameters (walking velocity, single limb support time, step length) while walking at a self-selected normal speed over a validated pressure mat.
Results: For all WOMAC subscales, PKA patients reported better scores than TKA patients (pain: $p < 0.01$, function: $p < 0.05$, stiffness: $p < 0.001$), and similar scores compared to controls. EQ-5D scores were comparable between PKA patients, TKA patients and controls. Knee extensor muscle strength did not differ significantly between PKA patients, TKA patients and controls, while TKA patients were weaker than controls ($p < 0.05$). PKA patients and controls demonstrated longer single limb support time than TKA patients ($p < 0.05$), with no difference between PKA and controls. Walking velocity and step length did not differ between PKA patients, TKA patients and controls.
Conclusion: This preliminary study showed that six months after surgery PKA patients reported better knee pain and function scores compared to TKA patients and similar scores compared to healthy controls. These results were partially supported by a better gait ability in PKA than TKA patients, which could potentially result from a worst recovery of muscle strength in TKA patients. Future research should however confirm these results at long-term follow-ups.

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Surgical management of recurrent musculotendinous hamstring injury in professional athlete

Dr Roland Gardon, Cabinet privé, Genolier/CH; Dr Bertrand Sonnery-Cottet, Centre Orthopédique Santy, Lyon, France, Lyon/FR

Background: Hamstring injury is the most common muscular lesion in athletes. The conservative treatment is well described and surgical management is often indicated for proximal tendinous avulsions. To our knowledge, no surgical treatment has been proposed for failure of the conservative treatment in musculotendinous hamstring lesions.
Purpose: The aim of the study is to describe the surgical management of proximal and distal hamstring musculotendinous junction lesion in professional athletes after failure of the conservative treatment.
Study design: Case series; Level of evidence, 4.
Methods: A consecutive series of ten professional athletes including four soccer players, four rugby players, and two handball players underwent surgical intervention between October 2010 and June 2014 for the treatment of recurrent musculotendinous hamstring injuries. All athletes had failed at least three months of conservative treatment for a recurrent musculotendinous hamstring injury, A surgical resection of musculotendinous scar tissue was performed with a longitudinal muscular suture. LEFS and Marx scores were obtained at three months follow up, and a final phone interview was completed to determine recurrence of hamstring injury and return to previous level of play.
Results: The mean average age at surgery was 25,2 years (19–35). The musculotendinous hamstring lesions involved eight semi-tendinosus and two biceps femoris with six injuries located proximally and four distally. Conservative treatment lasted in average 5.1 months (range 3–9) after last recurrence and the patients had in average of 2.7 (range 2–5) separate incidents of injury recurrence before surgical intervention was decided. At three month follow up, all patients had Marx activity scores of 16 and LEFS scores of 80. All 10 patients returned to the same level of play at an average of 3.4 months (range 2 to 5). At a mean average follow up of 28.7 months, none of the athletes had suffered a recurrence. No surgical complication was encountered.
Conclusion: In cases of failed conservative treatment of musculotendinous hamstring lesion, surgical intervention may be a viable treatment option in professional athletes and allows the patient to return to the same level of play.

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Meniscal extrusion and meniscal integrity correlate with increased bone tracer uptake in SPECT/CT

PD Dr. Michael Hirschmann, Kantonsspital Baselland, Bruderholz/CH; Jan Rechsteiner, Kantonsspital Baselland, Bruderholz/CH; Milos Dordevic, Kantonsspital Baselland, Bruderholz/CH; Dr. Anna Falkowski, Universitätsspital Basel/CH; Dr. Enrique Testa, Kantonsspital Baselland, Bruderholz/CH; Dr. Anna Hirschmann, Universitätsspital Basel, Basel/CH

Introduction: The purpose of this study was to precisely quantify the subchondral bone tracer uptake (BTU) in SPECT/CT of knees with different grades of meniscal lesions. It was the hypothesis that BTU is significantly increased in knees with meniscal lesions when compared to those without meniscus pathology.
Methods: Thirty-four consecutive patients (mean age 46 ± 12 years) with MRI and SPECT/CT within three months were prospectively collected and retrospectively included. Patients with previous intra-articular knee surgery as well as with grade 3-4 cartilage lesions were excluded. For analysis and comparison of MRI and SPECT/CT data a

specific localisation scheme was used. Maximum values of BTU (mean±standard deviation) for each area of the localization scheme were recorded as well as normalized values calculated. Meniscal lesions were graded in MRI according to Noyes (intact, degenerated, torn) by two experienced musculoskeletal radiologists blinded to the SPECT/CT findings. Extrusion of the meniscus was noted. To determine a significant difference in BTU between the extruded and non-extruded meniscus groups an independent t-test was used. For comparing the groups with various grades of meniscal condition ANOVA was used ($p < 0.05$).
Results: In knees with a degenerated meniscus significantly higher mean relative BTU was found when compared to knees with intact menisci ($p < 0.01$). Knees with a torn meniscus showed significantly higher mean relative BTU when compared to knees with intact menisci ($p < 0.01$). In knees with an extruded meniscus significantly higher mean relative BTU was found when compared to knees with non-extruded meniscus ($p < 0.01$).
Conclusion: Subchondral BTU values in SPECT/CT were significantly higher in knees with degenerated and torn menisci compared to knees with intact menisci. Similar significant difference in BTU was found between the knees with meniscal extrusion and those with menisci not extruded. These results suggest that SPECT/CT is able to detect patients with increased risk for OA development.

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Subchondral bone mineral density is heterogeneous on the femoral condyles and varies with osteoarthritis

Prof. Dr Brigitte Jolles-Haeberli, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland, Lausanne/CH; Vivien Meyer, Centre Hospitalier Universitaire Vaudois and University of Lausanne/CH; Pritish Chakravarty, Centre Hospitalier Universitaire Vaudois and University of Lausanne/CH; Alessandro Cavinato, Centre Hospitalier Universitaire Vaudois and University of Lausanne/CH; Dr Patrick Omoumi, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne/CH; Dr Julien Favre, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne/CH

Purpose: Although bones are among the tissues the most affected by knee osteoarthritis (OA), little is known about changes in subchondral bone structure. This study aimed to characterize the spatial variations in subchondral bone mineral density (BMD) in non-OA knees and test if properties differ in OA knees.
Method: CT-arthrography was performed on four end-stage medial OA knees and four matched knees without imaging signs of OA. Images were segmented to create 3D femur models. Each point on the surface of the model was given a BMD value, calculated as the average signal intensity over the CT-arthrography voxels in a distance of 3 mm from the surface point. Averages BMD were calculated for six regions of interest: the anterior, central, and posterior portions of the subchondral bone on both condyles. Medial/lateral (M/L) ratio was calculated for each region of each participant and t-tests were used to compare non-OA and OA knees with an alpha level at 5%.
Results: In non-OA knees, the M/L BMD ratio decreased from the anterior to the central and posterior regions. The ratio was significantly different between the anterior (where it was greater than 1.0 for all knees) and posterior regions (where it was lower than 1.0 for all knees). OA had significantly greater ratios than non-OA knees in the three regions. On average, OA ratios were 15%, 17%, and 9% larger in the anterior, central, and posterior regions, respectively.
Discussion: This study showed that BMD is heterogeneous along the condyles of healthy knees. Interestingly, BMD was greater in the medial condyle for the anterior and central regions, whereas in the posterior region BMD was greater in the lateral condyle. BMD is known to be conditioned by the mechanical stress, so these regional variations could be associated with the ambulatory function of the joint. OA resulted in a general increase in M/L BMD ratio, with the greater increases observed in the regions the most frequently loaded. These results agree with the regional differences previously reported in M/L cartilage thickness ratio and in walking pattern (knee adduction moment). Together the compositional differences in this study with the structural and functional differences previously documented confirmed the importance of a mechanical pathway in knee OA. While a larger cohort is necessary to derive any firm clinical conclusions, the results already suggested that a complete model of knee OA should include the spatial variations in subchondral BMD.

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Short graft reconstruction of the ACL and return to sport

Dr Jean-Yves Jenny, Hôpitaux Universitaires de Strasbourg, ILLKIRCH/FR; Dr Xavier Clement, Hôpitaux Universitaires de Strasbourg, ILLKIRCH/CH

Rationale: The donor site morbidity of the ACL graft harvesting may be harmful. Short graft reconstruction using just one hamstring tendon has been developed to decrease this morbidity without compromising the correction of the anterior laxity. The goal of the study was to assess the results of this technique for patients operated in a university knee department not involved in the development of the study. The hypothesis tested was that the delay of return to sport was longer than expected for conventional hamstrings reconstruction.
Methods: The study was monocentric and retrospective. Inclusion criterion was an arthroscopic assisted ACL reconstruction performed by two experienced knee surgeons using a 40 to 50 mm, 4- to 5-fold semi-tendinosus graft fixed by interference screws securing two polyethylene terephtalate bands without direct contact to the graft. 76 patients were selected with a mean age of 31 years. 4 patients were excluded (no sport activity prior to injury). All patients were followed for a mean period of 4.3 years (minimal follow-up = 18 months). Primary criterion was the delay to return to the sport activity practiced before injury. Lysholm, Tegner, KOOS and IKDC scores were analyzed as secondary criteria. Return to sports activity was allowed according to the patient's feeling, without any delay consideration.
Results: 66 patients (92%) returned to any sport activity. The mean delay was 4.1 months for running, 6.1 months for pivoting sports and 6.6 months for contact sports. Return to competitive sport was possible for 82% of the patients after a mean delay of 7.1 months. Return to work was possible for 96% of the patients after a mean delay of 2.3 months. Initial Tegner score was recovered for 71% of the patients. Mean Lysholm score was 91.4 points, mean KOOS score was 87.7 points, mean subjective IKDC score was 94.2 points, 88% of the patients were classified IKDC A or B. 4 repeat ruptures were observed, all of them after a significant knee injury.
Conclusion: Delay and rate of return to sports in the present study compared favorably with previously published literature. The rate of repeat rupture is not higher than accepted with conventional longer grafts. Despite the use of this shorter ACL graft without direct screw fixation, the functional results appeared to be at least as satisfactory as the gold standard grafts. The harvesting of only hamstring tendon might decrease the donor site morbidity.

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Ankle joint arthrodesis with an anatomically pre-shaped anterior locking plate: Preliminary results

Dr. Thomas Schlemmer, Oberwil/CH; Dr. Martin Wiewiorski, Universitätsspital Basel/CH; Dr. Alexej Barg/US;Prof. Dr. Dr. med. Victor Valderrabano, Universitätsspital Basel, Basel/CH

Introduction: Osteoarthritis (OA) of the ankle joint is a challenging problem. The most common surgical treatment methods include total ankle replacement and ankle joint arthrodesis. We describe the use of a novel anatomically pre-shaped implant for anterior ankle joint arthrodesis.
Methods: Eight consecutive patients with end-stage primary (N = 2) or posttraumatic (N = 6) ankle joint OA were enrolled into this prospective study. Ankle joint arthrodesis was performed using an anatomically pre-shaped anterior locking plate (Synthes, Solothurn, Switzerland) with an additional 7.3 mm compression screw through a modified anterior approach. Preoperative and postoperative clinical assessment included the visual analog scale (VAS) for pain and American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score. Radiographic fusion was defined as bridging callus on 3/4 cortices on weight-bearing conventional radiographs.
Results: The mean follow-up time was 14.5 ± 5.2 months (range, 7–20.5). At latest follow-up, 7 of 8 (87.5%) patients showed complete fusion at the arthrodesis site. One non-union occurred in one patient who was a smoker. The median time to fusion was 6 months in 7 patients with complete fusion (range, 6–12). The VAS score improved significantly from preoperative 6.1 ± 1.4 points (range, 4–8) to 4.1 ± 2.0 points (range, 0–7) ($p = 0.037$) The AOFAS score improved significantly from preoperative 38.9 ± 16.7 points (range, 13–57) to 58.0 ± 17.9 points (range, 24–84) ($p = 0.009$). No peri- or postoperative complications were observed.
Conclusion: Ankle arthrodesis with an anterior anatomically pre-shaped locking plate is a feasible and safe procedure resulting in a high consolidation rate. Further evaluation of this procedure is needed with higher numbers.

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The relative midfoot index as measure for impaired gait in ankle osteoarthritis

PD Dr. Arno Frigg, Kantonsspital Graubünden, Zürich/CH; Jennifer Goldoni, Universität Basel/CH; Dr. Martin Wiewiorski, Universitätsspital Basel/CH; Dr. Monika Horisberger, Universtitätsspital Basel/CH

Background: In a prior study evaluating healthy volunteers, ankle and tibiotalocalcaneal arthrodesis with pedobarography, the interpretation of a large number of pedobarographic parameters could be reduced to the interpretation of the midfoot index of load: Healthy volunteers showed a triphasic gait with a deep midfoot depression while with more extensive fusion, the midfoot depression became less and the gait more biphasic. This study aims to verify this observation in patients with ankle osteoarthritis.
Methods: We assessed 120 patients with ankle osteoarthritis (OA) prior to total ankle replacement surgery and 35 healthy volunteers (70 feet) with AOFAS-score and dynamic pedobarography (Novel emed m/E, St. Paul, MN, USA) in barefoot condition. Both feet were measured in all patients. Main outcome measures were the relative midfoot index (rMI), the relative contact time and maximal force (MF) in the hind-, mid- and forefoot. The rMI represents the relative difference in MF between the average of the hind- and forefoot and the midfoot (fig. 1), i.e. the extent of the midfoot's MF depression, (rMI = 1-MF midfoot/(MF forefoot+MF hindfoot)/2). The affected feet of the ankle OA and the contralateral non affected feet were compared to healthy feet with ANOVA and Bonferroni post hoc assessment. The AOFAS-score was set in relation to rMI with the Pearson correlation coefficient.
Results: The rMI was significantly smaller in the OA feet (0.65 ± 0.19 [standard deviation]) and contralateral feet (0.69 ± 0.15) than in healthy feet (0.84 ± 0.08, p <0.001). However there was no significant difference between the OA and contralateral feet. The rMI showed a correlation of 0.48 with AOFAS score in OA-patients and healthy volunteers. In all other parameters, the contralateral feet as well as the ankle OA-feet were significantly different than healthy feet (p <0.001).
Conclusions: The midfoot index is a valuable new pedobarographic parameter assessing a healthy or diseased gait in the clinical setting using pedobarography. The interpretation of a large number of pedobarographic parameters can be reduced to the interpretation of the relative midfoot index e.g. as simple as the interpretation of ST-elevation or -depression in a electrocardiogram. The contralateral feet of ankle OA patients are significantly different from healthy feet and not "healthy". Therefore they are not suitable as comparison group for a disease or surgical outcome.

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Comparative analysis of fixed and mobile bearing total ankle prostheses: effect on tibial bone strain and tibial component fixation

Dr Alexandre Terrier, EPFL, Lausanne/CH; Maïka Guilemin, EPFL, Lausanne/CH; Caroline Sieger Fernandes, EPFL, Lausanne/CH; PD Dr Xavier Crevoisier, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne/CH

Introduction: Two major types of ankle prosthesis exist: those with a fixed-bearing (FIX) and those with a mobile-bearing (MOB) insert. There are no clear reported advantages of one over the other. The MOB is thought to provide greater mobility, reduce polyethylene wear, and reduce bone and bone-implant stress, but this has not yet been verified. Thus, the goal of this paper is to compare these two prostheses through a validated finite element model.
Methods: Seven finite element models of tibia were built and validated with cadaveric data [1]. The geometry and elastic properties of the tibias were obtained from computed tomography of the cadaveric tibias. The cortical and trabecular bones were segmented and meshed separately. Three cases were compared on each tibia: a fixed prosthesis (FC), a mobile prosthesis with the mobile component in a centered position (MC), and a mobile prosthesis with the mobile component in an eccentric position (ME). We used the Talaris (FIX) and Salto (MOB) prostheses (Tornier, Inc. Edina, MN, USA). For the ME case, we considered an extreme anterior displacement of 3.67 mm of the MOB, which was estimated from in vivo measurements [2]. An axial compressive force of 5'560 N (5 times body weight) was applied. We evaluated octahedral shear strain within the tibia and bone-implant interfacial shear stress.). Statistical analysis included a one-way ANOVA or a Kruskal-Wallis test, depending on if the data was normally distributed or not.
Results: In all cases bone strain was maximal around the implant keel. Compared to the centered cases, strain distribution was slightly shifted anteriorly for the (anterior) eccentric mobile case (ME). Among all cases, the volume of bone strain above 1% varied from 0.11 to 7.07 cm^3. There were no significant (p >0.67) differences between the three cases. The peak of interfacial stress was located above the keel and at the plate rim. The area with an interfacial stress higher than 3 MPa varied from 0.96 to 3.76 cm^2. There were no significant (p >0.45) differences between the three cases.
Conclusion: The eccentric position of the mobile-bearing slightly increased the anterior peak strain, but not significantly. We concluded that, even if slight differences are observed between fixed and mobile-bearing inserts, it is not enough to put forward the superiority of one of one of them regarding their reaction to axial compression.

References: [1] Terrier 2014, [4] Leszko 2008, [3] Morgan 2001, [4] Berzins 1997.

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A descriptive analysis of the upper limb movement during gait in individuals with cerebral palsy

Dr. Geraldo De Coulon, HUG, Geneva/CH; Dr Alice Bonnefoy-Mazure, Geneva University Hospital, Geneva/CH; Dr Yoshi Sagawa, University Hospita Geneva/CH; Prof. Dr Pierre Lascombes, Universite de Geneve, Genève 1214/CH; Prof. Stephane Armand, University of Geneva, Geneva/CH

Introduction and aim: Patients with cerebral palsy (CP) are characterised by a large diversity of gait deviations; thus, lower limb movements during gait have been well-analysed in the literature [1]. However, the question of upper limb movements and, more particularly, arm movements during gait has received less attention for CP patients [2]. Thus, the aim of this study was to investigate upper limb movements for a large group of CP patients.
Patients/materials and methods: A retrospective search was used, including upper limb kinematic parameters and 92 CP patients (42 females and 50 males, mean ± standard deviation (SD); age: 15.2 ± 6.7 years). The diagnoses consisted of 48 Hemiplegic (HE) and 44 Diplegic (DI). A control group (CG) of 15 subjects was included in the study to provide normal gait data (7 females and 8 males, age: 18.4 ± 8.4 years). For the DI patients and control group, 88 arms and 30 arms were analysed, respectively. For the HE patients, 48 affected arms (HE-A) and 48 non-affected arms (HE-NA) were analysed. The kinematic parameters selected and analysed were shoulder elevation angles; elbow flexion angles; thorax tilt and obliquity angles; hand vertical and anterior-posterior movements; and arm angles [3, 4]. Statistical analyses were performed to compare CG with the affected and non-affected upper limbs of HE patients and with the two upper limbs of DI patients.
Results: The results showed that HE and DI patients have altered upper limb movements. Moreover, DI patients have greater arm angle (figure 1), shoulder and elbow movements (figures 2 and 3) compared with HE patients. HE patients adopt different shoulder movements between their affected (HE-A) and non-affected arms (HE-NA). Their non-affected arms have no differences with the arms movements of the CG excepted for the range of motion of their arms.
Discussion and conclusions: Arm movements have an important biomechanical role during CP gait for stabilisation, compensation and to develop strategies that optimise the gait despite the lower limb level impairments and poor balance control. Thus, the patients move their upper limbs especially as gait deviations are important. These observations confirm that the upper limbs must be integrated into rehabilitation programs to improve inter-limb coordination, to decrease energy expenditure and also to improve gait speed and gait patterns [5].

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The use of 3D planning and patient specific instruments for femoral osteotomy of a malunited pediatric fracture – a case report

Tobias Bühler, Orthopädiezentrum Kantonsspitäler Aarau/Baden, Aarau/CH; PD Dr. Karim Eid, Orthopädiezentrum Kantonsspitäler Aarau/Baden, Aarau/CH; PD Dr. Andreas Schweizer, Uniklinik Balgrist, Zürich/CH

Introduction: There are several reports of 3D supported technologies for planning of corrective osteotomies in the upper extremity. This method allows easier, reproducible correction with improved accuracy compared to conventional planning based on plain films. To our knowledge, there are no reports on corrective osteotomies of the femur in pediatric patients with patient specific cutting blocks.
Methods: A 12 year old boy with significant deformity due to a malunited fracture of the distal femur was treated with elastic titanium nails 6 months before. The patient had a flexion contracture of 20° and considerable malalignment of his leg. Deformity was assessed with segmented CT data to generate a 3D model of the femur which was compared with the contralateral side. The fracture was united in 22° varus, 29° flexion and 15° of external rotation. A single osteotomy plane was defined, which corrected the deformity exactly apart from a limb length deficit of 10 mm. By laser sintering technology one individual sawing/drilling guide and one correction guide was produced which intraoperatively fit the unique bone surface of the patient exactly.
Results: The osteotomy was performed uneventfully and the correction was internally fixed with a conventional, non-locking plate. A postoperative CT scan after 6 weeks showed an accurate correction of the deformity compared to the contralateral side concerning varus and flexion with a slight residual external rotation of 2°. Leg length discrepancy was already corrected by 5 mm. The osteotomy healed uneventfully within 3 months, the patient was painfree after 12 months with symmetrical function of the lower extremities.
Conclusion: Complex posttraumatic deformities of the lower limb in pedriatic patients can be accurately corrected with a 3D planned osteotomy. The technique allows the use of a single osteotomy and is easily applicable intraoperatively – particularly in the presence of considerable rotational deformities.

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Polydactyly of the foot – treatment strategies: when, what and how to plan and perform surgery

Dr. med Erica Lamprecht, Kantonsspital, Winterthur/CH

Purpose: Polydactyly of the foot is a common problem in newborns. The fifth and first ray are most commonly affected. The first ray polydactyly presents more complex problems. The deformity may be associated with other syndromes. The question in polydactyly is, when and how surgery has to be performed. Treatment is based on clinical, functional and radiological appearance. The multiformity of polydactyly demands in each case careful judgement before and during surgery.
Methods: We present 35 patients treated surgically for problems of polydactyly of the foot. 17 boys and 18 girls. Average age at first consultation ranged from 1 day to 22 years, mean 3yrs 7 months. Left foot involvement was found in 12 children, right foot in 11 patients and 12 patients with bilateral occurence. In 2 feet the supernumerous toe was a fifth toe in fibular hemimelia, the remaining 45 feet had six toes. The first ray was affected in 5 feet and herein 4 x with hallux varus. Central ray affection was present in 5 children, the remaining 37 duplications concerned the fifth ray. In our serie we found additional syndromes as 2 fibular hemimelias, 1 tibia antecurvata, 2 cleftfeet, 2 feet with macrodactyly, 1 constriction band, 1 down syndrom and 2 children with cerebral retardation. Polydactyly of the hand was present in 2 children. Surgical strategies were based on clinical appearance (interferance with shoes, developpment and function of the additional toe, ev. cosmesis) and the x-ray-interpretation. This means that we very rarely performed surgery before the end of first year. Age at surgery ranged from 12 month to 22 years, mean age 7 yrs 6 months. The surgical techniques included pure ablation of the supernumary toe, resection of the enlarged matatarsal head or shaft, resection of the whole ray and corrective osteotomies of bent metatarsals to diminish foot width. First ray duplication afforded resection of the duplicated toe and in 4 feet complex corrective osteotomies of first metatarsal with fibular graft interposition.
Results: We present the clinical and radiological results of our 35 operated patients with the aedequate surgical techniques.
Conclusions: Considering the pathology of polydactyly, the morphologic classification and X-ray evaluation (taken between 8 and 12 months of age), the described surgical techniques will lead to satisfying functional and cosmetical results and makes secondary corrective surgery in most of the cases unneccessary.

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Flexion-type supracondylar humeral fracture with traumatic ulnar nerve transection – a treatment approach

Dr. Christina Steiger, HUG Genève, Genève/CH; Dr. Geraldo De Coulon, HUG, Geneva/CH; Dr. med. Jean-Yves Beaulieu, HUG, Genève/CH

Introduction: Flexion-type supracondylar humeral fractures represent only 2–10% of all supracondylar fractures. The most commonly reported complication associated with this fracture type is an ulnar nerve injury. As the ulnar nerve passes behind the medial epicondyle it is under stress during anterior fracture displacement. In the majority of cases nerve injury due to stretching is minor and recovery is seen within 3 months. However, if muscle paralysis persists, further investigations need to be undertaken to rule out nerve entrapment at the fracture site or traumatic nerve transection.
Methods: We present a case of an eight-year- old girl who was admitted to our hospital with a flexion-type supracondylar fracture (type IV according to Lagrange and Rigault) and ulnar nerve palsy. Fracture treatment included closed reduction and lateral percutanous pinning. At 3 months the fracture was healed but there were no signs of nerve recovery. The standard workup for nerve lesions in our clinic comprises of MRI evaluation of nerve continuity, ultrasound (US) evaluation of fascicular integrity and electroneuromyography (ENMG) which were all obtained in this case.
Results: MRI imaging was inconclusive with regard to the continuity of the nerve. US examination showed an irregular fascicular structure at the fracture level with suspicion of nerve entrapment. The ENMG elicited no sensory or motor response. During surgical exploration a complete ulnar nerve transection was found. The nerve stumps were crossing each other and were attached to callus and fibrous tissue formation at the fracture site. Damaged nerve stumps were resected and to facilitate primary nerve suture the ulnar nerve was decompressed and transposed anteriorly using an intramuscular transposition technique.
Conclusion: Severely displaced flexion-type supracondylar fractures have a high incidence of ulnar nerve injury. In children spontaneous recovery after nerve compression- and distension injuries has been observed and thus it is commonly accepted to delay treatment of nerve palsy for 3 months. However, if after that time frame no nerve recovery is found we believe that imaging and neurological investigations are warranted. Although these investigations do not always conclusively display the nerve condition at the fracture site they allow evaluating nerve structure proximally and distally and thus are helpful for preoperative planning in case of suspected nerve entrapment or transection.

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Meniscus transplantation in skeletally immature patients

Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; Dr. Frances Tepolt, Children's Hospital Boston, Harvard Medical School/US; Prof. Dr. Mininder Kocher, Children's Hospital Boston, Harvard Medical School/US

Introduction: Skeletally immature patient patients can suffer from severe meniscal injuries and postmenisectomy symptoms. The most common reasons for this are overresection of discoid menisci or delayed treatment of menscial injuries – such as bucket handle tears – or ligamentous knee instability. While most patients can be managed with conservative measures until they reach skeletal maturity, some require earlier treatment. This study focuses on the surgical techniqe and short-term outcomes of meniscus transplantation in skeletally immature patients.
Methods: We reviewed our clinical patient database for skeletally immature patients undergoing meniscus transplantation with at least 18 months follow-up. Patients were contacted and invited for a physical exam, imaging, and given a PediIKDC, Lysholm, and Tegner score questionnaire. The study protocol was approved by the responsible IRB.
Results: Three patients (two females / one male) responded to our invitation and were available for physical exam and questionnaires. Two patients suffered from subtotal discoid meniscus resection leading to early lateral compartment degeneration. One patient suffered from advanced degeneration after a delay in treatment for a medial bucket handle tear due to an untreated ACL rupture. Their mean age at the time of surgery was 12.6 ± 2.3 years. At a mean follow-up was 31 ± 20 months. The mean PediIKDC score was 68.3 ± 4, the mean Lysholm score was 55.7 ± 22.3. The median Tegner score was 7 pts. There were no indications for growth deformity during the regular postoperative radiological assessments. One patient had to be revised for lysis of adhesions along the lateral mini arthrotomy and mobilization under anesthesia. The other two patients were able to

return to sports at the same level as before the transplant within 9 months postoperatively.
Conclusion: Overresection of discoid menisci as well as untreated meniscus injury, typically in conjunction with ligamentous instability, can lead to advanced cartilage degeneration and recalcitrant complaints necessitating surgical treatment before skeletal maturity. We were able to show that meniscal transplantation in skeletally immature patients leads to acceptable clinical outcome without growth deviation.

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Comparison of two different entry points for elastic stable intramedullary nailing in pediatric radius fractures

Anita Schulz, Kantonsspital Winterthur, Winterthur/CH; Dr. Ruth Gremminger, Kantonsspital Winterthur/CH; PD Dr. Christoph Meier, Kantonsspital Winterthur/CH; Dr. Mark Rudin, Kantonsspital Winterthur/CH; Dr. Emanuel Benninger, Kantonsspital Winterthur/CH

Introduction: Forearm fractures are common injuries in pediatric trauma. Fractures of the radial shaft or neck are less frequent than distal fractures but surgical treatment is required more often. Closed reduction and elastic stable intramedullary nailing (ESIN) through a retrograde approach is an established technique for displaced fractures. However, different entry points at the distal radius may be used for nail insertion. Aim of this study was to compare two different entry points.
Methods: Retrospective analysis of all pediatric fractures of the radius, either shaft or neck which were treated by ESIN between 2009 and 2014. Depending on the surgeon's preference, a titanium elastic nail (TEN) was percutaneously inserted in a retrograde fashion into the medullary canal through either an entry point at the lateral side of the radial styloid (RS) proximal to the epiphysis or at the dorsal side proximal to the tubercule of Lister (TL). All TEN were advanced into the proximal fragment and buried underneath the skin. Analysis included operation time, intra- /postoperative complications and complications related to implant removal.
Results: Ninety-three patients were included. In 80, the TEN into the radius was inserted through the RS and in 13 through the TL. No difference was found between the entry points regarding operation time either for insertion or removal. Most fractures healed within 4–6 weeks (range 3–23) unrelated to the entry point. All TEN were removed after 13 weeks (range 6–35). In the RS group, 3 (4%) temporary irritations to the superficial ramus of the radial nerve were observed. Two refractures, both due to an adequate trauma and one contracture were recorded. In the TL group, 1 (8%) rupture of the extensor pollicis longus tendon required revision surgery and 1 (8%) developed CRPS. Implant removal did not cause any complications.
Conclusion: Complications were related to the close proximity to structures such as nerves and tendons to the entry point. The danger of permanent injury to the superficial ramus of the radial nerve may be overestimated and was not observed in the RS group. In contrast, a tendon lesion which required surgical revision was found in the TL group. Despite the retrospective study design and the limited number of patients, our study may indicate that the RS may be preferred as entry point for retrograde ESIN of the radius.

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Femoral and tibial torsion measurements in children and adolescents: Comparison of MRI and 3D models based on low-dose biplanar radiographs

PD Dr. Leonhard Ramseier, Uniklinik Balgrist; Kinderspital Zürich, Zürich/CH; Dr. Andrea Rosskopf, Universitäsklink Balgrist/CH; PD Dr. Florian Buck, Universitätsklinik Balgrist/CH

Abstract: Purpose Femoral and tibial torsion measurements have been shown to be comparable to state of the art CT measurements. However, CT measurements as well as measurements on 3D models based on low-dose biplanar radiographs are associated with radiation exposure of the child. The aim of our study was to evaluate reliability and interchangeability of femoral (FT) and tibial torsion (TT) measurements in childrenusing magnetic resonance (MR) imaging compared to measurements on 3D models based on biplanar radiographs (BPR).
Materials and Methods: Institutional review board waiver was obtained. FT and TT were measured in 30children (mean age 10.1years; range 6.2–15.6 years; 14 female) using axial MR imaging scouts by two independentreaders. Measurements based on BPR 3D models by two separate independent readers served as reference standard. Interreader and intermethodagreement was calculated using descriptive statistics, Intraclass correlation coefficient (ICC) and Bland-Altman analysis.
Results: FT/TT was –6°–47°/+1°–44° on MR images and –13°–46°/9°–49° for measurements on BPR 3D models. The average difference between the two methods was 4.6° ± 4.1/6.0° ± 3.8, respectively. Interreader agreement (ICC)of FT/TT measurements was 0.97/0.96 on MR images and 0.99/0.94 on BPR 3D models. Intermethod agreement (ICC) for MR measurements was 0.93 (95% confidence interval [CI], 0.88–0.96) for FT and of 0.87 (CI, 0.39–0.95) for TT. Mean measurement differences between the two BPR readers were 2.1° (0.0°–7.0°) for FT and 3.4° (0.0°–12.0°) for TT. Mean interreader differences at MR were 3.2° (0.1°–8.0°) for FT and 3.5° (0.1°–9.5°) for TT. Bland-Altman plots showed no relevant differences between the twomodalities. Except for 3/4 measurements of FT/TT, all measurements on MR images were within the 95% limit of agreement.
Conclusion: FT and TT measurements in children using MR scout imagesare comparable to measurements on BPR 3D models.
Keywords: Femoral torsion; tibial torsion; children; adolescents; MRI; low dose BPR; 3D models Clinical relevance statement Femoral and tibial torsion measurements in children can be reliably performed without radiation exposure based on axial magnetic resonance imaging scouts.

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Treatment of delayed presenting Monteggia fractures with plastic ulnar deformity

Dr. Christina Steiger, HUG Genève, Genève/CH; Dr. Romain Dayer, HUG, Genève/CH; Prof. Dr Pierre Lascombes, Universite de Geneve, Genève 1214/CH

Introduction: Plastic deformity of the ulna and dislocation of the radial head has been classified as Monteggia variant fracture. When treated immediately ulnar bending can be reduced manually and usually leads to concomitant reduction of the radial head. Sadly, these fractures are often overlooked during primary assessment and thus delayed treatment after several weeks is often required. At this time point surgical correction of the ulnar deformity is the only option. We describe a procedure using percutaneous ulnar osteotomy and a flexible intramedullary nail (FIN) for stabilising the ulna after closed reduction of the radial head.
Methods: Between 2012 and 2014 we have treated a two- and a five-year-old patient for a late presenting Monteggia variant fracture. The delay between accident and diagnosis was 2 and 1 week respectively. In one patient the radial head was dislocated anteriorly (Bado I), in the other patient laterally (Bado III). In both cases a percutaneous ulnar osteotomy was carried out in the proximal third of the bone and flexion deformity was induced to facilitate reduction of the radial head. When stable reduction was achieved a slightly pre-bent FIN was introduced in an antegrade fashion, pushed forward crossing the osteotomy site and advanced to the distal ulna. The concavity of the nail faced the radius, pulling the radial head backwards into its normal position. At the end of surgery stability of the radial head was tested in pro- supination. Postoperatively the elbow was immobilised in a cast for 4 weeks, thereafter free mobilisation was encouraged. Clinical and radiological controls were carried out in regular intervals.
Results: No postoperative complications were encountered. Clinical outcome was excellent in both cases with a normal range of motion after 2 months. Full bone healing at the osteotomy site was observed in both cases at 3 months postoperatively. Metal removal was thus possible 6 months after the initial surgery.
Conclusion: In Monteggia variant fractures reduction of the radial head depends on retained flexion of the ulna at the osteotomy site. Flexible intramedullary nailing provides this stability but at the same time allows a certain degree of movement, thus promoting callus formation and rapid bone healing. The technique is relatively easy to learn, requires only a short time in the operating room and gives good results. Therefore, we recommend this treatment for delayed presenting Monteggia variant fractures.

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Case report: posterolateral corner injury with avulsion of the popliteus tendon in a paediatric patient

Dr Cindy Bouvet, HUG, Genève/CH; Prof. Dr Pierre Lascombes, Universite de Geneve, Genève 1214/CH; Dr. Christina Steiger, HUG Genève, Genève/CH

Introduction: The popliteus tendon and the lateral collateral ligament (LCL) are constituents of the posterolateral corner (PLC) of the knee limiting external rotation and posterior and varus translation of the tibia. PCL injuries are rare in the paediatric population and only a few cases of popliteus avulsions are described in the literature. We report on a PLC in a teenager.

Case description: A 14 years old boy was admitted to our hospital after a motocross accident where he sustained a twisting motion of his right knee. On clinical exam the knee was swollen with tenderness over the lateral femoral condyle. Anteroposterieur and lateral x-rays of the knee showed an avulsion fracture of the femoral condyle and an IRM confirmed a PLC injury comprising of an avulsion fracture of the femoral attachment of the LCL and a separate avulsion of the popliteus tendon.
Operative reconstruction: Surgery was conducted using a lateral approach to the knee. The LCL was found to be avulsed with a bone fragment measuring 14×4 mm and a periostal flap. In addition the popliteus tendon was detached at its bone origin on the femur. The bone fragment was reduced anatomically and held in place with a 3,5 mm cannulated srew with washer. The periostal flap was fixed using two staples. A Panaloc anchor (Depuy Synthes, Switzerland) was used to reattach the popliteus tendon. Postoperatively the knee was immobilised in a splint limiting knee flexion at 60° during 6 weeks.
Results: 3 months after surgery, the patient was painfree and could walk without any restriction. On physical examination knee flexion was 140° and extension 0° and there was no ligament instability. X-rays confirmed fracture consolidation. At 6 months the patient had taken up his former sports activities without symptoms.
Discussion: Diagnosis and treatment of PLC injuries in paediatric patients is important to restore knee function and stability. The popliteus tendon origin on the femur differs from the insertion of the LCL and can be overlooked on MRI imaging and intraoperatively. As the popliteus muscle is dynamic stabiliser of knee rotation we believe its reattachment is indicated in all young sportive patients with a PLC injury.

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Associations of diabetes mellitus with orthopaedic infections: epidemiological experience from Geneva

Dr Julien Billières, Geneva/CH; PD Dr Domizio Suvà, HUG, Genève/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH

Purpose: Clinical experience suggests that a high proportion of orthopaedic infections occur in persons with diabetes. Surprisingly, there is little epidemiologic data (other thanfor diabetic foot infection) concerning this issue.
Methods: We analysed several databases that we have compiled on adult patients hospitalised for orthopaedic infections at Geneva University Hospitals from 2004–2014. Group comparisons were done with the $\chi 2$ or the Wilcoxon-ranksum-test.
Results: We retrieved 2632 episodes of infection for which there were data about the presence of concomitant diabetes mellitus. Overall, diabetes was noted in the medical record for 637(24%) of these cases. The patients with, compared to those without, diabetes had >5times more foot infections (263/637 [41.3%] vs. 150/1995 [7.5%]; p <0.01) and a significantly higher serum CRP level at admission (median 102 vs. 70 mg/L; p <0.01). Diabetic patients were older (median 67 vs. 52 years; p <0.01), more often male(456/637 vs. 181/1995; p = 0.06), had more frequent polymicrobial infections (208/537 [38.7%] vs. 329/1753 [18.8%]; p <0.01), more isolates of gram-negative non-fermenting rods (85/241[35.3%] vs. 156/1753 [8.9%]; p <0.01) and skin commensals (53/265[20.0%] vs. 212/1753 [12.1%]; p = 0.06). Excluding foot infections from these analyses did not change the statistically significant differences. Diabetes was present in 17% of all infected orthopaedic patients without foot involvement. In Geneva the overall prevalence of diabetes is estimated at 5.1% while we have found that the prevalence is 13% in our hospitalised adults.
Conclusion: In Geneva, diabetes is present in 24% of all adult patients hospitalised for surgery for an orthopaedic infection, a prevalence that is several times higher than in for the general population and at least 1.5 times higher than for the population of hospitalised patients. Compared to non-diabetics, patients with diabetes have significantly more infections that are polymicrobial, contain gram-negative rods and skin commensals.

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Staphylococcus aureus versus β-hemolytic streptococci in orthopaedic infections

Dr Charles-Henri Wassmer, Hôpitaux Universitaires de Genève, Carouge/CH; PD Dr Domizio Suvà, HUG, Genève/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH

Purpose: Clinical experience suggests that S. aureus tends to form abscesses (e.g., carbuncles, septic bursitis), whereas streptococci more often cause phlegmons and diffuse spreading infections (e.g., erysipelas, necrotizing fasciitis). Wewere interested in comparing the clinical presentation and measurable evidence of virulence of infections caused by S. aureus and β-hemolytic streptococci, especially S. pyogenes.
Methods: We reviewed clinical informationfrom databases of adult orthopaedic patients hospitalized at Geneva University Hospitals. We excluded patients with polymicrobial infections or who had received antibiotic therapy prior to admission. Group comparisons were made with the Pearson-χ^2-test.
Results: Among 1229 different evaluable orthopaedic infections, 666(54%) were caused by S. aureus, and 168(14%) by various streptococci, with 39 (3%) caused by S. pyogenes. Of the 834 episodes caused staphylococcal or streptococcal, 122(15%) were accompanied by bacteraemia. Comparing infections caused by S. aureus vs. all streptococci, there were no significant differences in sex, age, presence of diabetes mellitus or other immune suppression, serum CRP levels, percentage with infections of the foot, osteoarticular sites, or fracture-devices. In contrast, infections caused by S. aureus was significantly more often associated with bacteraemia (83/666 vs. 39/168; p <0.01), abscess formation (333/666 vs. 61/168; p <0.01), septic bursitis (219/666 vs. 28/168; p <0.01), and prosthetic joint infections (70/666 vs. 27/168; p = 0.046), while necrotizing fasciitis was significantly more often caused by monomicrobial streptococcal infection (0/666 vs. 1/168; p = 0.046). A comparison of infections caused by S. aureus s. S. pyogenes alone yielded similar results, with the only significant difference being that S. pyogenes tended to be associated with a higher serum CRP level (median 95 mg/L vs. 76 mg/L; p = 0.05).
Conclusions: Our results confirm the clinical impression that infection withS. aureus is significantly associated with abscess formation, prosthetic joint infection and bacteraemia compared to β-hemolytic streptococci and that S. pyogenes tends to be associated with a high serum CRP level.

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Fever and its association with infection in polytrauma patients

Dr Sylvain Steinmetz, Martigny/CH; Dr Sophie Abrassart, Hôpitaux Universitaires de Genève, geneve/CH; Prof. Dr Pierre J. Hoffmeyer, Hôpitaux Universitaires de Genève/CH;PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH

Purpose: Polytrauma patients often receive preemptive or prophylactic antibiotic therapy because of the high risk of infection and long-lasting posttraumatic fever. We investigated factors associated with proven infection and its association with fever.
Methods: Using a prospectively maintained database of patients hospitalised for severe polytrauma in our intensive care unit we conducted a case-control study with outcome infection. We investigated the overall and daily occurrence of fever (T° ≥38°C axillary) during the first 15 days and its association with various categorical (Pearson-χ^2-tests) or continuous variables (Wilcoxon-ranksum-tests).
Results: Among 155 patients with an episode of polytrauma, fewer occurred in 80 (54%) despite the prescription of anti-inflammatory drugs in all cases and also corticosteroids in 15 cases. Overall, 120 patients underwent surgery, including for open fractures in 30 cases. The percentage of patients who were febrile was 48% on day 2 of hospitalization 52% on day 7 and 40% on day 15. Among 90 patients (58%) who were receiving antibiotic treatment during the two-week window, infection was proven microbiologically and clinically in 25 patients (16%), of whom 6 (4%) fulfilled the criteria for sepsis. There were 10 episodes of pneumonia, 2 urinary tract infections, 2 bloodstream infections, 10 abdominal infections and 1 soft tissue infection. Overall, 22 of 80 (27.5%) febrile patients developed infection in contrast to 3 of 65 (4.6%) non-febrile patients (Pearson-χ^2-test; p <0.01). In predicting infection, fever had a sensitivity of 88%, specificity of 57%, positive-predictive value of 28% and negative

predictive values of 96%. Using daily stratified analyses with categorical and continuous temperature variables confirmed the statistical association of fever with infection for each day (all p values <0.01). By multivariate analysis, fever had an independent significant associated with infection (odds ratio 9.2, 95%CI 2.5–34.5); while surgery, open fractures, compartment syndrome pelvic trauma, facial trauma, abdominal trauma, and use of urinary catheters did not. The goodness-of-fit-value was 0.37 and the ROC value 0.85, indicating a high accuracy of our final model.
Conclusion: For polytrauma patients in the intensive care unit, both fewer and antibiotic prescriptions are frequent. Fever is significantly associated with infection both overall and stratified upon individual days, with no apparent time threshold.

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What duration of antibiotic therapy is needed after surgical treatment of patients hospitalized for soft-tissue diabetic foot infections (DFIs)?

Dr Sophie Abrassart, Hôpitaux Universitaires de Genève, geneve/CH; Dr Sylvain Steinmetz, Martigny/CH PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH; PD Dr Domizio Suvà, HUG, Genève/CH

Purpose: The recommended duration of post-surgical antibiotic treatment for soft tissue DFIs is 10–20 days. As there are few studies to inform an evidence-based approach, clinicians often treat for longer durations.
Methods: We conducted a retrospective case-control study of patients hospitalised in the Septic Orthopaedic Ward at Geneva University Hospitals, for whom we have a detailed database. We conducted a multivariate analysis with a cluster-controlled (at the level of the patient) Cox regression model, defining treatment failure as a clinical recurrence ≥14 days after treatment ended. We defined the follow-up as time until a clinical recurrence or the last available clinical data.
Results: We found 64 episodes of DFIs: 7 abscesses; 12 infected necrotic tissue; 8 cellulitis; 16 purulent ulcers; 16 other infected ulcers; 5 proven toe osteomyelitis with soft tissue infection. All infected bone was surgically removed, two had angioplasty before surgery, four received negative pressure wound therapy. The most commonly isolated pathogen was Staphylococcus aureus and the most frequently prescribed antibiotics were amoxicillin/clavulanate, clindamycin, co-trimoxazole, ciprofloxacin and cefuroxime. The median total duration of treatment was 20 days, 5 days of which was intravenous. After an average follow-up of 7 years,clinical recurrence at the same site occurred in 23 episodes (36%), with only 3(5%) caused by the same microorganism (S. aureus). By multivariate analysis, only the duration of diabetes (hazard ratio 1.1, 95%CI 1.01–1.30) and a low trans-coetaneous oxygen gradient of the forefoot (HR 1.1, 1.02–1.10) were significantly associated with recurrences. There was no association with number of surgical interventions, use of vacuum devices, duration of antibiotic total antibiotic therapy (HR 1.0, 0.99–1.05) or intravenous antibiotic therapy (HR 1.0, 0.98–1.10).
Conclusion: Our analysis of soft tissue DFIs did not define a threshold for the optimal duration of antibiotic therapy after surgical debridement. As only 5% of patients had a recurrence with the same organisms, suggesting shorter durations may be as efficacious as longer ones. In view of the known hazards of unnecessarily prolonged antibiotic therapy, these limited data support shorter treatment duration for these patients.

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Risk factors for treatment failure of infected sacral pressure sores

Dr Sylvain Steinmetz, Martigny/CH; Dr Sophie Abrassart, Hôpitaux Universitaires de Genève, geneve/CH; Prof. Dr Pierre J. Hoffmeyer, Hôpitaux Universitaires de Genève/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH

Infected sacral pressure soares are difficult to treat and have a high risk of recurrence. There is little in the published literature regarding the outcome of treatment and long-term follow-up of these infections.
Methods: This is a single-centre (HUG) epidemiologic study of spinal cord injured adults seen between 1995–2014 with an infected sacral pressure soared. Statistical analyses included cluster-controlled (at the level of the patient) Cox regression analysis with emphasis on surgery and the duration of antibiotic therapy. We included only infections accompanied by purulent secretions or proven osteomyelitis. Infections associated with osteosynthetic material and subjective variables such as patient adherence to treatment or duration and frequency of long-term were off-loaded.
Results: We found 70 eligible episodes in 31 patients with a median follow-up of 2.7 years. Underlying osteomyelitis was present in 52 cases. The median duration of hospitalization was 3 months. The patients had a median of 1 surgical intervention, with concomitant flap used in 25 cases. The median duration of targeted antibiotic therapy 6 weeks including at least 1 week of intravenous treatment. Overall, 44 episodes (63%) there was a clinical recurrence after a median interval of 1 year. In 85% of these recurrences culture of the wound yielded a different organism than the index infection, suggesting re-infection rather than relapse. In various multivariate analyses, no variable was significantly associated with clinical failure. The number of surgical interventions (hazard ratio [HR] 1.1, 95%CI 0.8–1.6), use of flap, bone involvement (HR 1.5; 0.7–3.1), immune suppression, prior sacral infections, duration of total antibiotic prescription (HR 0.9; 0.5–1.4) or use of parenteral antibiotic therapy were not associated with failure. Specifically, antibiotic treatment for <6 weeks had the same risk as>12 weeks. Similarly, duration of antibiotic therapy did not alter the risk of recurrence with the same pathogen (Pearson-χ^2-test; p = 0.90).
Conclusions: Our retrospective study of spinal cord injured patients with an infected sacral pressure soares demonstrated that infection recurrence occurs in almost two-thirds of patients, but in only a minority with the same pathogens. The number of surgical debridements, performance of a flap, or duration of antibiotic therapy was not associated with recurrence, suggesting recurrences are due to re-infections caused by other extra-hospital factors.

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Is bioactive glass a valid bone substitute after debridement of infected or contaminated bone?

Patrick Goetti, Lausanne University Hospital, Lausanne/CH; Dr Aron Grazioli, Lausanne University Hospital/CH; Dr Nicolas Gallusser, Lausanne University Hospital, Lausanne/CH; PD Dr Olivier Borens, Lausanne University Hospital, Lausanne/CH

Introduction: Treatement of infected or contaminated bone implies resection of devitalised bone and soft tissues resulting in bone defect and lack of bone coverage. Proposed treatment options are the use of antibiotic loaded polymethymethacrylate (PMMA), autologous bone graft and bone substitues. Recently bioactive glass (BAG) has been shown to have a large spectrum of antibactericial activity. The antimicrobial effects of BAG are mainly related to the creation of a hostile environment for the bacterial adhesion and proliferation due to calcium and sodium ions as well as phosphorous salts combined with an increase of local pH and of osmotic pressure. Associated with it's osteoconductive and angiogenic propreties it seems to be an excellent substitute. To our knowledge there is only one study reporting results of use of BAG in a septic environement. We report our preliminary results with the use of BoneAlive®.
Methods: Retrospective case review.
Results: We reviewed the outcome of the use of bioactive glass (BoneAlive®) in 7 bone defects in 5 patients. Mean age was 42 (32–50), and mean follow-up was 12 months (5–36). All patients were treated by a wide debridement, followed by systemic antibiotics. In all cases 10cc of BoneAlive® was used, and in 2 cases it was augmented, one time by tricortical iliac crest graft and lateral plate osteosynthesis, the other by autologous cancelous bone graft. Two patients needed soft tissue bone coverage, one gracilis free flap and one fascio-cutaneous flap (28%, 2/7). Consolidation rate was 100% (7/7), there was one case of peristance infection with staphylocoque aureus, 14% (1/7) treated by plate removal, debridement, BAG was retained.
Conclusion: Bioactive glass shows encouraging outcome when used after debridement in a septic field. Further studies with a higher case load and longer follow-up are needed to confirm these results.

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Outcome of treatment of diabetic foot infections (DFIs) associated with colonisation or infection with MRSA or ESBL

Dr Jean-Christophe Richard, Hôpitaux universitaires de Genève, Geneve/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH

Purpose: It is suggested, but heretofore not proven, that body colonisation or infection caused by multiresistant microorganisms is associated with a higher failure rate in patients treated for a DFI.
Methods: We conducted an epidemiologic survey in our hospital to determine the rate of successful treatment of DFIs in patients with, versus without, concomitant colonization or infection with methicillin-resistant S. aureus (MRSA) or extended-spectrum-lactamase (ESBL)

carrying bacilli. In our hospital, the overall prevalence of MRSA or ESBL colonisation on admission is 5%for each. We defined colonisation as a swab yielding one of these organisms during the two weeks before or after the start of antibiotic therapy for the DFI. MRSA carriage was swabbed in the nares, wound and the groin. ESBL was swabbed perianally and in the wound. All statistical tests of comparisons are with Pearson-χ^2-tests.
Results: Among 517 episodes of DFI from 2008–2014, 244 (47%) recurred after a median surveillance period of 2.4 years (range 60 days–5 years). The median duration of antibiotic therapy overall was 14 days (range, 0 to 315 days) and almost all had at least one surgical intervention. Among all DFI episodes, MRSA was isolated from 80 (15%), 77 of which were from clinical samples. Colonisation/infection with MRSA tended to be associated with prior antibiotic exposure for a DFI (14/80 vs. 55/517; p = 0.08), and significantly lowered treatment success of the current episode (28/80 vs. 244/517; p = 0.04). In 24 (5%) of the DFI episodes patients had rectal or urinary colonisation with ESBL. There was no association of ESBL colonisation/infection with prior antibiotic treatment for DFI (14/24 vs. 65/517; p = 0.56),nor did it affect the success of DFI treatment (10/24 vs. 234/517; p = 0.73).
Conclusion: In patients with a diabetic foot wound, MRSA is usually considered to be a pathogen, and it is three times more prevalent than ESBL carriage in our DFI patients. The rate of ESBL carriage among patients with DFI is similar to that among the general patient population in our hospital. Infection or colonization with MRSA, but not ESBL, may be associated with failure of treatment of DFI.

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Acetabular manifestation of CML mimics septic arthritis of the hip

Dr. Guy Waisbrod, Luzern Kantonspital, Luzern/CH;
Dr. Judith Bering, Kantonspital Luzern, Luzern/CH;
PD Dr. med. Martin Beck, Kantonspital Luzern, Luzern/CH

Introduction: Chronic myelogenous leukemia (CML) is a malignant clonal disorder of hematopoietic stem cells. Leukemic synovitis is known to be a rare complication of it. It is characterized by joint pain and swelling and usually affects large joints i.e. hip and knee. Patients refer to health care providers with complaints of pain, dizziness and fatigue. Fever and shiver might be additional signs. While imaging studies can be often nonspecific, preexisting osteoarthritis or rheumatoid arthritis are reported to be associated. Diagnosis is usually established based on synovial fluid examination and synovial biopsy. Interestingly diagnosis of septic arthritis is based on the same parameters, and clinical manifestation shares the same signs and symptoms from leukemic synovitis.
Case: We present a rare case of a 55 year-old male patient with clinical symptoms, imaging and laboratory findings suggesting a septic joint infection. Consequently an open joint lavage was performed, followed by a second look procedure with tissue biopsy and repeat microbiologic examination. Surprisingly histology revealed the evidence for CML, while positive findings of staphyloccus epidermidis suggested a secondary joint infection. Thus following therapy included a tyrosine kinase inhibitor targeting the neoplastic disease and antibiotics to address the infection.
Discussion: Joint pain without previous trauma is a common complaint encountered in daily hospital routine. Septic arthritis is one of the most important causes, while diagnosis remains to be challenging as it is relying on clinician's expertise as much as on laboratory test that are nonspecific. Adult leukemic synovitis is reported to be a rare feature of CML and is in few cases reported to be the initial manifestation. Its characteristics do not differ much from that of a septic joint infection and can be neither ruled out nor confirmed by imaging nor by synovial fluid white blood count, while biopsy can be falsely negative because infiltration can be local.
Conclusion: As both diseases are associated with severe morbidities but can be treated effectively when diagnosed, it is important that clinicians are aware of and careful with this rare condition.

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Variables associated with cure in surgical site infections of the spine

Dr Julien Billières, Geneva/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH; Dr Guillaume Racloz/CH

Objective: Concerning infections after orthopaedic and traumatologic spine surgery, little is known regarding therapeutic factors associated with cure. Likewise, we ignore the optimal duration and administration route of antibiotic therapy. Methods: Single-centre study 2008–2014 including adult orthopaedic patients. Statistical analyses included cluster-controlled (at patient level) Cox regression with emphasis on the number of debridements and the duration of antibiotic therapy.
Results: Among 556 interventions in the study period, 25 (4%) became infected (median age 68 years, 9 immune-compromised). We detected 16 different pathogen constellations, among which Staphylococcus aureus predominated. Spondylodesis material was involved in 21 cases involving 21 episodes with screws, 3 cages and 20 rods. The therapeutic approach consisted of surgical debridements (median number of 3 interventions (range, 1–12) and a targeted antibiotic therapy for a median duration of 6 weeks (range, 5–54 wks); of which a median of 2 weeks intravenously (range, 0–18 wks). For 14 episodes, rifampicin was used in combination therapy, while 18 episodes benefited of vacuum-assisted (VAC) devices. Eight cases also had local antibiotics such as bacitracin and vancomycin. Overall, 21 infections (21/25; 84%) were cured after a median follow-up of 3.6 years. In all 4 recurrences, wound cultures yielded the same organism than the index infection (methicillin-susceptible and methicillin-resistant S. aureus in two episodes each). In further univariate analyses, the number of surgical interventions, the duration of antibiotic therapy, sex, age, immune-suppression, serum CRP levels, leukocytosis, smoking status, or VAC use were statistically unrelated to cure. In multivariate analysis, the number of surgical interventions (hazard ratio [HR] 1.1, 95%CI 0.9–1.2) and antibiotic-related parameters did not influence cure. Specifically, antibiotic administration for <6 weeks revealed the same success as >6 weeks (HR 1.2; 0.4–3.3); and <2 weeks intravenously as much as >2 weeks (HR 0.6; 0.2–1.5).
Conclusion: In our small retrospective cohort of orthopaedic material-related spine infections, all failures were due to S. aureus, while the number of debridements or the duration or the administration route of antibiotic agents did not influence cure.

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Corticosteroid injection for hip arthritis prior to total hip arthroplasty – is it safe? A systematic review

Luis Carlos Pereira, CHUV, Lausanne/CH; Prof. Dr Brigitte Jolles-Haeberli, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland, Lausanne/CH

Background: Intra-articular steroid hip injection (IASHI) is advocated by the Society of Musculoskeletal Medicine for the treatment of stage II and stage III osteoarthritis (OA). When conservative approaches fail, total hip arthroplasty (THA) should be considered to reduce pain and restore function. There is debate in the literature whether ipsilateral IASHI prior to THA leads to an increased incidence of prosthetic infection. Using a systematic review, the authors sought to investigate whether there is an increased risk of postsurgical infection in patients who underwent IASHI prior to THA.
Methods: PubMed, Embase, PEDro, Web of Knowledge and The Cochrane Library were searched for articles published in English or French from 1990 to 2013. Studies that focused on IASHI and infection rate following THA were included. Retrieved articles were independently assessed by two authors for their methodological quality.
Results: Nine reports matched the criteria. Two studies recommended against IASHI prior to THA; seven found no risk with IASHI pre-THA. No prospective controlled trials were found; the majority of studies were retrospective. Lack of information regarding the methodology was a consistent flaw.
Conclusions: The literature is scarce, and the evidence is weak, as most studies were retrospective and confounding factors were poorly defined or not addressed. Using modern aseptic techniques, IASHI administered no less than two months before THA does not appear to increase infection rates following THA. High quality, prospective, randomized trials are needed to substantiate these findings.

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What proportion of clinical recurrences of diabetic foot infections (DFIs) are microbiologically due to new pathogens?

Dr Charles-Henri Wassmer, Hôpitaux Universitaires de Genève, Carouge/CH; PD Dr Domizio Suvà, HUG, Genève/CH; Dr Sophie Abrassart, Hôpitaux Universitaires de Genève, geneve/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH

Purpose: Clinical recurrences of DFIs are common and most often attributed to a failure of adequate surgical or antibiotic treatment of the initial infection. This study was designed to investigate how many recurrences at the same anatomical site are caused by new pathogens.
Methods: We developed a single-centre database of patients hospitalized for treatment for DFIs, defined according the IDSA guidelines. We excluded patients with a foot wound without evidence of infection and those who had received recent antibiotic therapy. Pathogen identification and determination of antibiotic susceptibilities were performed routinely in the clinical microbiology laboratory.
Results: Among 517 episodes of DFI, a recurrence occurred in 244 (47%) after a median of 2.4 years (range 60 days–5 years). The median duration of prior antibiotic therapy was 14 days (range, 0 to 315 days) with a median duration of intravenous therapy of 2 days (range, 0 to 90). Almost all patients had undergone at least 1 surgical intervention (range, 0 to 5, including 120 amputations). Among these 244 recurrences, 157 (64%) had isolates from their wounds that were not identified (among the three main pathogens) during the preceding episode.
Conclusion: Our results suggest that up to two-thirds of recurrent DFIs at the same anatomical localisation may be due to new pathogens. This retrospective analysis needs further investigation by with sophisticated bacterial typing methods. This high rate of new pathogens in recurrent infections may be related to surgical site infections or selecting of pathogens by previous antibiotic use.

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Clinical and epidemiological differences between implant-associated and implant-free orthopaedic infections

Dr Céline Cuérel, Saint-Sulpice VD/CH; PD Dr Ilker Uckay, Hôpitaux Universitaires de Genève, Genève/CH; PD Dr Domizio Suvà, HUG, Genève/CH; Dr Sophie Abrassart, Hôpitaux Universitaires de Genève, geneve/CH; Dr Julien Billières, Geneva/CH

Purpose: The presence of an implanted foreign body is a major risk for infection. Although there have been many publications regarding the epidemiology and risk factors for implant-associated orthopaedic infections, few studies have investigated how clinical presentations may differ between infections with and without osteosynthethic material.
Methods: We pooled clinical data from several databases of adult patients with orthopaedic intections hospitalised at Geneva University Hospitals from 2004 and 2014. We compared groups using the Pearson-χ^2-test or the Wilcoxon-ranksum-test.
Results: Among 2632 episodes of orthopaedic infections, 76% were implant-free osteoarticular or soft tissue infections. Among the 636 (24%) infections that involved osteosynthetic material, 312 (49%) were total joint arthroplasties, 143 single plates, and 50 single nails. The remainders were mixed implant infections, e.g., pins, wires, screws, spondylodeses, or cerclages. The implant-associated, compared to the implant-free, infections were significantly more frequently associated with: male sex (403/636 vs. 595/1996; p <0.01); older age (median 57 vs. 54 years; p <0.01);and infections caused by skin commensal pathogens, e.g., coagulase-negative staphylococci, corynebacteria, propionibacteria (131/636 vs. 466/1599; p <0.01).I n contrast, implant-associated infections ere significantly less frequently associated with: bacteraemia (99/636 vs. 212/1996; p <0.01); immune suppression (177/636 vs. 803/1996; p <0.01); abscess formation (79/636 vs. 917/1996; p <0.01); polymicrobial pathogens (103/597 vs. 434/1733; p <0.01); and foot infections (25/636 vs. 388/1996; p <0.01). The serum CRP levels at admission were similar (median 77 mg/L vs. 75 mg/L; p = 0.21).
Conclusions: Compared to implant-free infections, implant-associated orthopaedic infections are more likely monomicrobial and due to skin commensals, but less often associated with bacteraemia, immune suppression, or abscesses.

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Intercalary resection of the forefoot and reconstruction by a vascularized double-barreled fibula transfer

Dr. Stephan Keller, Universitätsklinik Balgrist, Zürich/CH; David Bauer/CH; Pietro Giovanoli/CH; PD Dr. med. Norman Espinosa, Pfäffikon/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: We present a case of an 11 year old female patient who was referred to our institution after incomplete resection of a monophasic synovial sarcoma (G2) of the left forefoot (Whoops-lesion). The parents and the patient initially decided against surgery and preferred polychemotherapy and radiotherapy. Twelve months after radiotherapy a new suspect lesion was seen at the left forefoot at the same region. An ultrasound guided biopsy confirmed a recurrence of the monophasic synovial sarcoma. The interdisciplinary sarcomaboard recommended surgery. One option was the resection of the tumor together with the first and second metatarsal preserving the metatarsal heads and reconstruction by a double-barreled fibula. Another option was a Syme-amputation. Together with the patient we decided for a resection and a double-barreled fibula reconstruction preserving the metatarsal heads.
Method: With the patient in supine position, the level of the skin incision was defined depending on the dimension of the tumor as assessed by preoperative imaging and planning to ensure safe margins. After a radical tumor resection including the first and second metatarsal with surrounding soft tissue a reconstruction with a double-barreled fibula skin graft was performed preserving metatarsal heads. The double-barreled fibula was fitted in the space between the metatarsal heads and the cuboid bone and fixed by plates and screws. Dorsalis pedis artery and greater saphenous vein were anastomosed with the fibula pedicle.
Results: Pathohistological results of the specimen confirmed a monophasic synovial sarcoma with microscopically negative resection margins. Four weeks after this reconstruction an ischemia of the skin graft was seen and a free gracilis-flap was performed.
Conclusion: After an intercalary resection of the metatarsal bones a reconstruction with double-barreled fibula graft seems to be a viable but technically demanding treatment option. Care has to be taken when choosing appropriate soft tissue coverage. In cases where amputation can be avoided from an oncological point, a multidisciplinary team of experienced surgeons for technically advanced limb reconstruction is required.

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Mismanagement of a soft tissue mass resulting in forequarter amputation: a case report

Dr. Florian Wanivenhaus, Universitätsklinik Balgrist, Zürich/CH; Dr. Stephan Keller, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: We present a case of a 61 year old female that was referred to our institution after resection of an inframammary lipogenous tumor (size: 16×11×6 cm) without prior imaging. The aim of this case report is to demonstrate the correct workup of a soft tissue mass according to the minimal workup requirements established by the Swiss National Sarcoma Advisory Board (SNSAB) and it will demonstrate the frustrating outcome after initial mismanagement.
Methods: A thorough workup of the past medical history including the review of all surgical notes, radiological imaging, and histology was performed. The case was discussed interdisciplinarily at the local sarcoma board before further treatment was initiated.
Results: In 2009 an inframammary swelling was resected without prior imaging. Histologically a benign lipoma was diagnosed, but no murine double minute-2 (mdm2) staining was performed to rule out an atypical lipoma. In April and May 2014, again without imaging, soft tissue masses located infraclaviculary and axillary were resected. Histologically an atypical lipogenic tumor was diagnosed, again without mdm2 staining. After the third operation the first radiological imaging (MRI) demonstrated a radiographically aggressive tumor with a heterogeneous mass in direct contact to the subclavian vessels and the plexus brachialis. Pulmonary and abdominal metastases were ruled out. This triggered the decision by the local tumor board to recommend radiotherapy followed by wide excision. The patient was finally referred to a sarcoma center and the available histology was read by a sarcoma pathologist, after completion of mdm2 staining. The histological diagnosis of an atypical lipogenic tumor was confirmed. After completion of the radiotherapy an MRI imaging was performed

and demonstrated a 62×56×53 mm heterogenous soft tissue mass that has increased in size since the first imaging. Although radiotherapy has been performed, a biopsy of the soft tissue mass was done and demonstrated a dedifferentiated liposacroma. In favor of achieving "widest" margin possible an extended forequarter amputation was performed after detailed discussion with the patient.
Conclusion: The recommended minimal workup requirements by the SNSAB (www.sarcoma.ch) provide reasonable ways how to work up a patient with bone and soft tissue lesions, keeping fatal outcome to a minimum. Management of sarcoma patients should only be performed after consultation with a multidisciplinary sarcoma board.

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Intercalary elbow amputation and heterotopic replantation of the distal forearm and hand in case of a synovial sarcoma

Dr. Paul Borbas/CH; Keller Stephan/CH; PD Dr. Maurizio Calcagni, UniversitätsSpital Zürich, Zürich/CH; Pietro Giovanoli/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: We present the case of a 19-year-old man with a biphasic synovial sarcoma of the right proximal forearm. After neoadjuvant chemotherapy the surgical treatment was planned. Decision had to be made between amputation and a hand-preserving surgery, the so called "resection-replantation". Together with the patient we decided for a resection-replantation surgery.
Methods: After radical tumor resection including the elbow joint, double plate osteosynthesis of the distal humerus to the distal radius and ulna was performed. Brachial artery was anastomosed with a y vein graft to the ulnar and radial artery. Furthermore, cephalic and basilic vein were anastomosed. Biceps and brachialis muscles and tendons were split and sutured to the flexor tendons of the forearm as well as triceps tendon was sutured to extensor muscles of the forearm. Median and ulnar nerve stumps and sensory nerves were coapted with epineural sutures. Finally, open carpal tunnel release was performed. On the third postoperative day hand therapy was started with mobilization of the wrist and fingers.
Results: No complications were noted. At 6 months' follow up there was no sign of local or systemic tumor recurrence.
Conclusion: The functional result has been deemed successful so far with slow improvements according to the reinnervation process. It will be evaluated 1 year postoperatively, if further surgery can be performed in case of disturbing functional deficits.

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Demographic analysis of patients with osteosarcoma, chondrosarcoma, Ewing's sarcoma from one single Sarcoma Center in Switzerland

Sandro Hodel/CH; Franziska Seeli/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: To assess presentation, diagnosis and outcome of the three most common primary bone tumors including osteosarcoma, chondrosarcoma and Ewing's sarcoma.
Methods: Retrospective analysis of presentation, diagnosis and outcome of osteosarcoma, chondrosarcoma and Ewing's sarcoma was performed for a single Sarcoma Center at the University Hospital Balgrist, Zurich. Descriptive statistics was performed for histological subtype, imaging, localization and first course treatment. Overall-survival was calculated using Kaplan-Meier's analysis.
Results: 201 patients admitted to Balgrist with osteosarcoma (n = 85, since 2000), chondrosarcoma (n = 73, since 2000) or Ewing's sarcoma (n = 43, since 1990) were included. Overall-survival for five and ten years were 74% ±6%, 69%, ±7% for osteosarcoma, 86%, ±5%, 78% ±9% for chondrosarcoma and 85% ±7%, 80% ±9% for Ewing's sarcoma.
Conclusion: The here presented 5-year-and 10-year-overall-survival rates (osteosarcoma 74% ±6%, 69%, ±7%, chondrosarcoma 86%, ±5%, 78% ±9%, Ewing's sarcoma 85% ±7%, 80% ±9%) from a single Sarcoma Center in Switzerland appear to be equivalent to other large international monocenter studies. The presentation and epidemiology of our patients are in accordance to large multicenter epidemiology studies. A nationwide sarcoma database (SwissSARCOS; www.sarcoma.ch) seems indispensable for more detailed analysis and quality management in such rare diseases.

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Internal Hemipelvectomy and reconstruction with a new hip transpositionplasty

Dr. Anita Hasler, Universitätsklinik Balgrist, Zürich/CH; Dr. Stephan Keller, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Compared to surgical treatment on the extremities, functional reconstruction after wide tumor resection about the pelvis is challenging. According to the different types of pelvic resections, there are different concepts how to achieve the optimal conditions for the remaining mobility. We present the medium-term results after hemipelvectomy, extra articular resection of the hip joint and reconstruction with a new hip transpositionplasty in a 55 year old male with a large 2° chondrosarcoma of the acetabulum involving the hip joint.
Methods: Preoperative work-up showed chondrosarcoma grade 2 of the right acetabular region reaching up to the sacroiliac joint, with infiltration of the surrounding soft-tissues. No evidence of metastases. The tumor infiltrated the SI-Joint and showed an interruption of the corticalis. The tumor expansion required an Enneking Typ I/II/III/IV resection including extra-articular resection of the hip joint. Because of high complication rates after allograft and endoprosthetic as well as the difficulty to fix them securely on the sacral vertical osteotomy, we favoured the hip transpositionplasty. The operation was performed on June 12th, 2014: A triradiate incision was performed. After intra- and extrapelvic dissection, including subtotal detachment of the pelvi-femoral muscles, the tumor was exposed. First, an intertrochanter osteotomy was performed. Furthermore, osteotomy of the ramus superior pubis, ischium, as well as an osteotomy lateral to the foramina on the sacrum was realized. All vessels and nerves could be protected. A Trevira®-tube was used to fix the remaining femur to the sacral osteotomy. Moreover a second Trevira®-tube from the ramus superior to the ischium, was attached as a functional hypomochlion to the vertical Trevira®-tube.
Results: Pathoanatomical analysis confirmed the diagnosis and showed R0 tumor resection. At the follow up of six months, the patient showed no local or distant tumor recurrence. He could walk with two forearm crutches, inside the house he walks without. There was no leg length discrepancy.
Conclusion: In situations were a wide resection of the entire hemipelvis is necessary, a hip transpositionplasty may offer a good solution with substantially lower incidence of complications with nevertheless good functional outcome.

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Prosthetic reconstruction with only minimal iliac bone left after type II / III internal hemipelvectomy for periacetabular chondrosarcoma

Dr. Ramin Herschel, Universitätsklinik Balgrist, Zürich/CH; Kourosh Modaressi/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Functional reconstruction after adequate tumor resection about the pelvis in young, demanding patients is challenging. Particularly, when the proximal osteotomy is close to the SI-joint. We present the short-term results after left internal hemipelvectomy and prosthetic reconstruction of a 45 year old female yoga instructor with a large °2 chondrosarcoma of the pelvis.
Methods: Preoperative workup showed °2 chondrosarcoma in the left periacetabular region, with intra- and extrapelvic soft-tissue-extension and no evidence of metastases. Left internal hemipelvectomy type II/III was indicated and performed on March 3rd, 2013: After intra- and extrapelvic dissections, including subtotal detachment of the pelvi-femoral muscles, the tumor was exposed. It presented as a gross mass in the periacetabular bone, with intrapelvic extension and bulging through the greater sciatic notch. Thereby it compressed the inferior gluteal nerve and vessels, which were sacrificed. The sciatic nerve was closely related to the tumor but was spared. En-bloc resection of the tumor by performing a type II / III hemipelvectomy was carried out, including also the hip joint and femoral neck. A Charnley-type osteotomy of the greater trochanter was performed to facilitate exposure and reinsertion of the abductor mechanism. Reconstruction of the hip mechanism was performed using a LUMIC® press-fit anchoring device in the remaining posterior iliac bone combined with a LUMIC®-cup (Implantcast). A press-fit femoral stem (Medacta) and a double mobility head were implanted. A Trevira®-tube was used to reinforce hip stability and muscular reinsertion. The osteotomized trochanter was reattached onto the femur and the remaining muscles were reattached to bone before wound closure.

Results: Patho-anatomical analysis confirmed the diagnosis and showed adequate tumor margins. At 22 months from the operation the patient shows no local or distant tumor recurrence. She walks normally and performs a one-leg-stand on both sides, refers some fatiguability. She has gone back to perform yoga with moderate limitations. She refers moderate pain in the sacral and iliac region, requiring analgesics on a regular basis.
Conclusion: A modular system that allows fixation of a prosthetic hip-mechanism in a small remaining posterior iliac mass can result in good functional outcomes after internal hemipelvectomy, even in a young and active patient. However, long-term follow up has to be awaited.

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Histiocytic sarcoma of the soft tissues after acute lymphoblastic leukemia – a challenging situation in a young patient

Dr. Anita Hasler, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH; Pietro Giovanoli/CH; Kourosh Modaressi/CH

Introduction: Tumor surgery with the aim of total resection of the tumor mass while preserving the maximum of function is challenging, especially in young demanding patients and neoplasms involving the extremities. We present an unusual case of a twenty year-old patient with a giant histiocytic sarcoma of the soft tissues on the right elbow and subsequent secondary metastasis in the axilla.
Methods: Preoperative workup showed a histiocytic sarcoma measuring 13×9×16 cm. The tumor had completely destroyed the distal humerus and involved surrounding soft tissue with even ulceration of tumor mass. It encased the neurovasculars bundle, but there was no evidence of metastases. We decided to perform a two-step surgery, first resecting the tumor en bloc ("intercalary amputation" of the elbow) and subsequent replantation of the forearm to the stump of the upper arm. The operation was performed with a team of tumor- and reconstructive surgeons. The distal amputation was done first, followed by dissection of the brachial plexus distal to the axilla and resection of the tumor block within the planned margins. The bones were readapted by two plates, the neurovascular structures were reanastomosed microsurgically and the forearm was successfully replanted. The pathoanatomical analysis confirmed the diagnosis and showed tumor free margins. Three months postoperatively the patient was basically pain-free, even he couldn't use the hand function yet. Unfortunately at this time the patient complained about a node in the axilla. Biopsy showed a metastasis of the known sarcoma. After conducting chemotherapy, the anatomical situation only allowed a forequarter amputation, an R0-resection being the goal. The extensive amputation including scapula, costae I, II, pleura and clavicular osteotomy was performed five months after the primary surgery in cooperation with thoracic surgeons. The pathoanatomical analysis showed a R0 resection.
Results: 10 months after the second surgery, the patient had adapted well to the new circumstances and remained disease free. He referred a pain level of 2/10 VAS and had restarted a professional education.
Conclusion: Complex situations as described can only be managed by an interdisciplinary team requiring large efforts and flexibility from everybody involved. Young and active patients can adapt surprisingly well to situations primarily associated with a significant loss of function and physical integrity.

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Fibrous dysplasia of the proximal femur – use of the trochanteric slide osteotomy for treatment

Dr. Ines Raabe, HFR Fribourg – Hôpital Cantonal/CH; Dr Darius Marti, HFR Fribourg – Hôpital Cantonal, Cressier/CH; Prof. Dr Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH

Introduction: Fibrous dysplasia (FD) is a benign intraosseous tumor which can be monostotic as well as polyostotic. It can also be seen in combination of extraosseous symptoms such as café-au-lait spots and several endocrine deregulations. FD is a genetic determined disease and can be interpreted as a result of a malfunction of osteogenesis which leads to loss of bone structure and strength. Main location is the femur often in the region of its neck followed by the tibia, the humerus, the clavicle, the skull and the pelvis. If the FD lesion is small it is mostly an incidental finding. Bigger lesions are often symptomatic and the patients affected report localized pain. The operative treatment depends on location of the FD, its extension and the solidity of bone.
Case report: We present a 22-year-old female with a symptomatic monostotic form of fibrous dysplasia in the femoral neck associated with fatigue-induced undisplaced fracture lines of the cortex of the neck but without the typical shepherd crook deformity or coxa vara. Therefore, the primary goal of the treatment was the curettage and bone grafting of the osseous lesion as well as the stabilization of the femoral neck with an angular stable implant. Looking to the location and extension of the bony defect a Gibson like approach with trochanteric slide osteotomy was chosen giving complete access to the lesion without additional femoral neck fenestration. Curettage of the FD was performed and the cavity filled up with autologous bone harvested from the anterior pillar up to the gluteus medius tubercle. A 2-hole 130° angular blade plate was used for internal fixation. The osteotomy of the greater trochanter was stabilized with two 3.5 mm cortical screws and cerclage wiring.
Results: 6 months postoperatively the patient was pain free and showed a full range of motion of the hip. Radiographically, the bone graft was completely restructured and the fatigue fracture of the neck as well as the slide osteotomy had healed uneventfully.
Conclusion: The trochanteric slide osteotomy offers surgical access to the inside of the femoral neck. This is advantageous in case of an extended bony lesion where additional fenestration of the neck leads to additional damage and further destabilization of the neck.

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Internal hemipelvectomy with "flail hip" for Ewing sarcoma of the iliac wing. A case report

Patrick Goetti, Lausanne University Hospital, Lausanne/CH; Dr Nicolas Gallusser, Lausanne University Hospital, Lausanne/CH; Maurice Matter, Lausanne University Hospital/CH;Antonia Digklia, Centre hospitalier universitaire de Lausanne/CH; Prof. Wassim Raffoul, Centre hospitalier universitaire de Lausanne/CH; Dr Igor Letovanec, Centre hospitalier universitaire de Lausanne/CH; Dr Fabio Becce, Centre hospitalier universitaire de Lausanne, Lausanne/CH; PD Dr Hannes Rüdiger, Zürich/CH; Dr. Stéphane Cherix, Centre hospitalier universitaire de Lausanne, Lausanne/CH

Introduction: Surgical resection of pelvic sarcomas is particularly challenging, due to the complex bony anatomy and close relationship to abdominal and pelvic viscera, nerves and major blood vessels. Internal hemipelvectomy is a limb sparing resection of the hemipelvis. No reconstruction of the pelvic ring and hip leads to a so-called "flail hip". We present a case of of Ewing sarcoma of the iliac wing and acetabulum treated with this technique.
Methods: Case report Results: A 30 y.o. patient presented with a localised bulky Ewing sarcoma of the iliac wing and acetabulum, invading glutei and iliac muscles. He was subjected to Euro Ewing protocol chmeotherapy. Local treatment consisted in wide en bloc internal hemipelvectomy with a "flail hip", sparing the femoral and sciatic nerves. After 2 weeks, a large wound necrosis was treated with a pediculated quadriceps and gracilis flap. Adjuvant chemotherapy was performed according to the protocol. He was allowed to start weight-bearing after 3 months.
Conclusion: Internal hemipelvectomy with "flail hip" is a rare surgical indication. The advantages of this limb-sparing surgery must be balanced against its numerous potential complications. More complex reconstructions of the pelvic ring and hip joint with allograft or endoprostheses bear an even higher risk of complications. In Ewing sarcoma and osteosarcoma, such complications may delay initiation of adjuvant chemotherapy and hence impair oncological outcome.

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Surgical oncological strategic score

Prof. Dr Pierre-Yves Zambelli, CHUV, Lausanne/CH; Dr Kerstin Hageman, UNIBE/CH; Prof. Dr Pierre Lascombes, Universite de Geneve, Genève 1214/CH

The choice of surgical strategy after neoadjuvant chemotherapy remains difficult because of the diversity of locations, vascular implications, age of the child. This "blurring" sometimes results in late information to the family and the team, which plays a deleterious role in management. Our goal was to develop a strategic objective score based on nine variables to define, from the diagnosis, management strategy for the tumor local control. This strategic score is based on 9 criteria: Criterion 1: age: the child still retaining a large potential for growth will pose reconstruction problems due to residual growth. Young age compared to the possibilities of reconstruction and resection rather plays a negative role. (x 1 to 0.1) Criterion 2: The location of the tumor. Because of the consequences of amputation at the upper limb,

we will investigate more conservative strategies at this level (+ 5 to 3) Criterion 3: diaphyseal or epiphyseal localization. Clearly diaphyseal lesions will be simpler resection and in this sense will lead a rather positive on strategic opportunities. (+ (5 to 0) Criterion 4: The size of the tumor. It undoubtedly plays a role with the particularity of juxtacortical osteosarcoma. (+ 0 to 5) Criterion 5: metastasis will not influence resection strategy, they nevertheless play a role, to avoid delay in resumption of chemotherapy. (+ 5 to 1) Criterion 6: Pain almost impossible to relieve despite aggressive measures may in some situations lead to rapid amputation. (x 1 to 0.1) Criterion 7: joint invasion. It will actually complicate the resection is more increased challenge. (+ 3 to 1) Criterion 8: neurological or vascular invasion. It is clear that invasion of the neurovascular bundle by going against the tumor-specify rescue or member of conservation solutions. On contrary, millimeter values may be tolerated depending on the localization and the compartment. (x 1 to 0.1) Criterion 9: Pathological fracture theoretically required amputation in order to achieve extra-compartmental resection. The decision remains controversial in the literature. (3 to 0)
Result: This score based on these nine points has allowed to determine the absolute indication for amputation, or conservative surgery. Intermediate scores allow conservative surgery but with difficulties that should be highlighted.
Conclusion: This simple score can be used as part of the Board tumor at diagnosis. It informs and family from the future integrated surgical strategy in the therapeutic.

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Bone tumors of the femoral neck – a new technique for biopsy and resection

Dr. Ulrich Lenze, Universitäts-Kinderspital beider Basel, Basel/CH; PD Dr. Andreas Krieg, Universitäts-Kinderspital beider Basel/CH

Introduction: Biopsy taking in patients with bone tumors of uncertain dignity is a crucial step within the diagnostic cascade. Open biopsy is still considered the gold standard. However, in certain anatomical locations such as the femoral neck, intramedullary bone tumors are sometimes difficult to access. Therefore, the surgeon runs the risk of sampling errors or contamination of the surrounding soft tissue during biopsy or curettage of benigne tumors. We present a new technique for the biopsy and treatment of difficult accessible bone tumors.
Methods: For the new technique a regular biopsy punch as well as a tube system are needed. The latter are usually used for the retro-/antegrade knee access in intramedullary nailing in order to avoid contamination of the knee with reaming material. The tube system is positioned over a guide wire and a special centering tool for opening the medullary cavity directly towards the bony lesions. For the following, the tube system serves as an entry portal and working channel to prevent contamination of the surrounding tissue with biopsy material. Once in the right position, rigid reamers of different sizes (for breaking the sclerotic boarders) and a regular biopsy punch can be inserted via special reduction sleeves. The bony lesion is now biopsied using the biopsy punch and/or a sharp curette. After biopsy, the medullary canal is reclosed with the original punching cylinder of healthy bone in order to prevent bleeding into surrounding soft tissue structures. After the benign character of a lesion is confirmed by histopathology, the same system can be used for curettage and filling with bone graft without contamination of the surrounding tissue.
Conclusion: The use of a tube sytem as well as a biopsy punch is a helpful tool for biopsy and treatment of difficult accessible bone tumors. The described technique may help to prevent sampling errors and contamination of surrounding structures with tumor material or post-biopsy bleeding.

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Second to third-ray transposition after re-excision of an epithelioid sarcoma of the middle finger

Dr. Stefanie Hirsiger, Uniklinik Balgrist, Zürich/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Ladislav Nagy/CH; Kourosh Modaressi/CH

Introduction: Amputation of the long finger can lead to severe functional compromise. Several procedures have been described to improve functional outcome. Second ray transposition after middle finger amputation was described by Carroll in 1959 and has since been used to optimize postoperative function. Indications vary from traumatic injuries to neoplastic lesions or rarely congenital deformities. Reconstruction following surgery of neoplastic lesions can be extraordinarily challenging as margins of resection can interfere with standard incisions.
Methods: We present a case of a 33-year old patient treated surgically with a third ray resection after R2-Resection of an epithelioid sarcoma on the proximal phalanx of his middle finger. First symptoms were noticed five years earlier and initially treated conservatively. After progression of the tumor mass a giant cell tumor was suspected and excised via z-plasty. Histologic examination thus showed an epithelioid sarcoma and the patient was referred to our center for further treatment. MRI-imaging showed no signs of metastatic lesions and wide excision of the third ray with sparing of only the minimum of commissural skin with consecutive transposition of the second ray was planned.
Results: The surgical intervention was performed successfully. Histopathologic analysis showed an R0-resection, although there was microscopic intraneural growth extension with a minimum margin of 0.5 mm on the proximal ulnar side. The wound and osteotomy sites healed uneventfully and adjuvant radiotherapy was conducted. There was satisfying regain of function and no signs of recurrence three months postoperatively.
Conclusion: So called “whoops-resections” are challenging as contamination of the surgical field widens resection margins and thereby impedes reconstructive measures. Third ray excisions even with relatively wide margins and adjuvant radiotherapy can thus be treated by second to third ray-transpositions with satisfying outcome.

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An unusual presentation of Angiomatoid fibrous histocytoma – a case report with focus on the value of radiation and chemotherapy of metastasized disease

Dr. Kersten Berndt, University hospital Balgrist, Zürich/CH; Gabriela Studer/CH; Beata Bode/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Due to its low risk for the development of distant metastasis, angiomatoid fibrous histocytoma (AFH) is classified as a tumor of intermediate malignancy. Only a minority of AFH is localized deep to the fascia. However, deep localization is associated with a higher incidence of distant metastasis and wide resection is the treatment of choice. Nevertheless, there might be a role for combination therapy with radiation subsequent to R1 resection or difficult/incomplete resection adjacent to neurovascular structures or in case of recurrence.
Methods: Herein, we report an unusual aggressive course of deep AFH with an osseous metastasis in the cervical spine with the development of neurological deficit in a 24-year old male with multiple episodes of recurrences. The primary tumor located deep to the fascia of the thigh was wide resected at the age of 16, with borders of the specimen free of tumor. Four months after index surgery, intramedullary osteolytic lesions in the distal meta- and epiphysis of the femur occurred and increased in number and size rapidly. Following the subsequent 19 months, several local and one distant metastasis in the lung were detected. Consequently, the situation was interpreted as a generalized metastatic disease and the patient received a chemotherapy including vincristin, doxorubicin and ifosfamid. However, chemotherapy was discontinued after three cycles due to side effects and tumor progression. Thigh amputation was performed due to a pathologic fracture with a fistulating osteomyelitis of the distal femur 4.1 years after primary tumor resection. The patient presented with myelopathy due to a lytic bone metastasis in the 5th cervical vertebra 7.4 years after index surgery. Angioembolization and intra-lesional resection of the tumor at C5 was performed and repeated for fast recurrence after 6 weeks. Total resection was not possible due to contact between tumor and vertebral artery. Therefore, after the second debulking a local radiation with 29 x 2.15Gy = 62.35Gy was performed.
Result: Neither recurrent debulking nor local radiation could avoid recurrence of an aggressive distant metastasis in the 5th cervical vertebra with progressive loss of motor function.
Conclusion: This case and two comparable cases, reported previously in the literature, suggest that neither chemotherapy nor radiation of metastases may improve patient outcome in generalized disease with a primary AFH localized deep to the fascia.

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Bone marrow derived mesenchymal stem cells transduced with Sox-9 Improve rotator cuff healing in a rat model

Dr. Michael Schär, Orthopädie und Traumatologie, Universität Bern, Bern/CH; PD Dr. Richard Ma, Hospital for Special Surgery, New York City/US; Camila Carballo, Hospital for Special Surgery, New York City/US;Will Gu, Hospital for Special Surgery, New York City/US; Ashley Titan, Hospital for Special Surgery, New York City/US; Marco Sisto, Hospital for Special Surgery, New York City/US;PD Dr. Matthias Zumstein, Inselspital Bern, Bern/CH; Dr. Xiang-Hua Deng, Hospital for Special Surgery, New York City/US;Prof. Dr. Scott Rodeo, Hospital for Special Surgery, New York City/US

Introduction: Given the suboptimal healing response after rotator cuff (RC) repair, biologic methods may have the potential to augment healing following repair. Sox-9 is a transcription factor, that is expressed at high levels in chondrocytes. It remains a central determinant of the lineage fate and differentiation of chondrocytes in the growth plate. Since enthesis development follows pathways similar to those seen in growth plate development, Sox-9 might also play an important role in enthesis formation and healing in the RC. The purpose of this study was to determine if bone marrow–derived mesenchymal stem cells (MSCs) genetically modified to overexpress adenoviral mediated Sox-9 (Ad-Sox-9) can improve healing of the tendon-to-bone insertion site after RC repair. We hypothesized that the application of these cells would result in better biomechanical properties of the RC reconstruction and an insertion site that would more closely resemble the native insertion site in terms of overall composition and structure.
Methods: 10 Lewis rats were used for the harvest of the MSCs. On the day of surgery, these cultivated passage 3 MSCs were transfected with 100'000 viral particles of Ad-Sox-9 per cell for two hours. RTqPCR was performed to confirm that Sox-9 was overexpressed in the MSCs that were implanted into the shoulders. A total of 60 mature Lewis rats underwent unilateral detachment of the supraspinatus tendon. In 30 of these rats, 1 mio adenoviral Sox-9-transduced MSCs in a fibrin sealant carrier were placed in between the tendon and the bone before suture repair (Sox-9). 30 rats received an acute suture repair only (control). Animals were sacrificed after 2 and 4 weeks. Biomechanical testing was performed in 12 rats and histological analysis in 3 rats per time-point and group.
Results: At 2 weeks, the Ad-Sox9 group had higher ultimate load to failure (Sox9: 11.00 ± 2.73N vs control: 8.79 ± 2.10N; p = 0.04), higher stiffness values (Sox9: 8.42 ± 1.87N/mm; control: 6.03 ± 1.62N/mm; p = 0.005). No differences were found at the 4 week time-point with respect to the ultimate load to failure (Sox-9: 22.18 ± 4.37N; control: 23.33 ± 6.17N; p = 0.85) and stiffness values (Sox-9: 12.65 ± 4.99N/mm; control: 14.77 ± 4.72N/mm; p = 0.19).
Conclusion: MSCs genetically modified to overexpress Sox-9 may accelerate initial RC healing in a rat model. However, further studies are needed to determine what the impact is on the initial healing response but also the long-term outcome in larger animal models.

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The effects of patient, injury and surgical variables on the PROMs following meniscus repair

Dr. Oludolapo Sotade, Gatton/AU

Purpose: This literature review has the primary objective of identifying the effects of key patient, injury and surgical characteristics on the validated Patient Reported Outcome Measure Scores (PROMs) following meniscal repair. The secondary objective is to analyse the predictive value of each of these variables with regard to a positive PROM score following arthroscopic meniscus repair.
Methods: We performed a systematic literature search of the MEDLINE, Cochrane and EMBASE databases, using the terms 'menisc*', 'outcome*', and 'repair'. Only literature using specific validated PROMs as outcome measures was included, such as Lysholm, Tegner, IKDC and KOOS. 35 full-text studies met the inclusion criteria and were included in the review.
Results: Methodologic weaknesses in some studies limit the evidence base. To date, the 2014 study by Cox et al was found to be the most comprehensive. Cartilage damage and meniscus tears were predictive of outcome six years after anterior cruciate ligament repair surgery (ACLR). Patient-characteristic predictors of worse outcome scores included lower baseline scores, a higher BMI, a lower education level, smoking, and revisions. No surgical characteristics were associated with a higher PROM score except concomitant ACLR. No injury characteristics had predictive value either.
Conclusions: There is limited evidence on the effects of patient, surgical and injury-related variables on the outcome of meniscus repair. While some studies illustrate the relationship between variables and outcomes, a model for the interaction between the different variables themselves does not exist. Such a model would be invaluable in determining surgical options.

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Prognostic value and in vitro biological relevance of Neuropilin 1 and Neuropilin 2 in osteosarcoma

Alex Boro/CH; Matthias Arlt/CH;Harrald Lengnick/CH; Bernhard Robl/CH; Knut Husmann/CH; Josefine Bertz/CH; Walter Born/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Neoadjuvant chemotherapy in osteosarcoma increased the long-term survival of patients with localized disease considerably but metastasizing osteosarcoma remained largely treatment resistant. Neuropilins, transmembrane glycoproteins, are important receptors for VEGF dependent hyper-vascularization in tumor angiogenesis and their aberrant expression promotes tumorigenesis and metastasis in many solid tumors. Therefore, our objective was to investigate expression of NRP1 and NRP2 in an OS tissue microarray and in a panel of osteosarcoma cell lines, and investigate in vitro the importance of Neuropilins in VEGFR signaling.
Methods: Tissue microarray of 66 osteosarcoma patients was immunostained and analyzed for Neuropilin-1 (NRP1) and Neuropilin-2 (NRP2) expression. Using reverse transcription-polymerase chain reaction (RT-PCR) we analyzed NRP1 and NRP2 expression in a panel of 9 osteosarcoma cell lines as well as expression of VEGF and VEGF receptors. To address the functional relevance of Neuropilins for VEGF signaling we used shRNA mediated down-regulation and blocking antibodies of NRP1 and NRP2 in the metastatic 143B and HuO9-M132 cell lines.
Results: We identified NRP2 as an indicator of poor overall, metastasis-free and progression free survival while NRP1 had no predictive value. Patients with tumors that expressed NRP2 in the absence of NRP1 had a significantly worse prognosis than NRP1-/NRP2-, NRP1+ or NRP1+/NRP2+ tumors. Moreover, patients with overt metastases and with NRP2-positive primary tumors had a significantly shorter survival rate than patients with metastases but NRP2-negative tumors. Furthermore, the expression of both NRP1 and NRP2 in osteosarcoma cell lines correlated to a variable degree with the metastatic potential of the respective cell line. VEGFA signaling monitored by AKT phosphorylation was more inhibited by blocking of NRP1, whereas in HuO9-M132 cells NRP2 blocking was more effective indicating that NRP1 and NRP2 can substitute each other in the functional interaction with VEGFR1.
Conclusions: Altogether, these data point to NRP2 as a powerful prognostic marker in osteosarcoma and together with NRP1 as a novel target for tumor-suppressive therapy.

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Staphylococcal biofilm formation on the surface of three different calcium phosphate bone grafts – A qualitative and quantitative in-vivo analysis

Dr. Martin Clauss, Kantonsspital Baselland, Liestal/CH; Bertrand Betrisey, CHUV/CH; Prof. Dr. Marc Bohner/CH; PD Dr Olivier Borens, Lausanne University Hospital, Lausanne/CH; PD Dr. Thomas Ilchmann, LEONARDO – Ärzte für Orthopädie und Traumatologie, Münchenstein/CH; Dr. Ulrika Furustrand Tafin/CH; Prof. Dr. Andrej Trampuz/CH

Differences in physico-chemical characteristics of bone grafts to fill bone defects have been demonstrated to influence in-vitro bacterial biofilm formation. Aim of the study was to investigate in-vivo staphylococcal biofilm formation on different calcium phosphate (CaP) bone substitutes. A foreign-body guinea-pig infection model was used. Teflon cages prefilled with β-tricalcium phosphate (β-TCP), calcium-deficient hydroxyapatite (CDHA), or dicalcium phosphate (DCP) scaffold were implanted subcutaneously. Scaffolds were infected with 2x103 CFU of Staphylococcus aureus (2 strains) or S. epidermidis and explanted after 3h, 24h or 72h of biofilm formation. Quantitative and qualitative biofilm analysis was performed by sonication followed by viable counts, and microcalorimetry, respectively. Independently of the material, S. aureus formed increasing amounts of biofilm on the surface of all scaffolds over time as determined by both methods. For S. epidermidis, the biofilm amount decreased over time, and no biofilm was detected by microcalorimetry on the DCP scaffolds after 72h of infection. However, when using a higher S. epidermidis inoculum,

increasing amounts of biofilm were formed on all scaffolds as determined by microcalorimetry. No significant variation in staphylococcal in-vivo biofilm formation was observed between the different materials tested. This study highlights the importance of in-vivo studies, in addition to in-vitro studies, when investigating biofilm formation of bone grafts.

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Prospective clinical evaluation of a new anatomic cuff for forearm crutches

Ansgar Arnieri/CH; PD Dr. Annegret Mündermann, University Hospital Basel, Basel/CH; PD Dr. Thomas Hügle, Universitätsspital Basel, Basel/CH

Background: Due to demographic changes, an increasing number of individuals depends on permanent walking aids. The use of forearm crutches is associated with pressure load on hands and forearms which can lead to overuse symptoms such as pain, skin bruises or nerve compression. We have recently shown that the main pressure on the forearm during forearm crutch walking is located along the ulnar bone.
Objectives: To clinically evaluate a recently developed anatomic cuff for forearm crutches.
Methods: A clinical pilot study was performed. The design was prospective, longitudinal and uncontrolled with a 4 weeks follow up. Nine patients permanently using conventional forearm crutches for degenerative joint or spine impairment were included. Participants used the forearm crutches with novel anatomically shaped cuffs (Ulnar Pro, Rebotec, Quakenbrueck, Germany) and an anatomic handgrip. The SF36v2 health survey and a questionnaire accessing pain, paraesthesia, comfort and sense of security based on 9-point Likert-scale were used to assess clinical improvement from baseline to the 4-week study end point.
Results: Pain ($p = .005$) and paraesthesia ($p = .003$) over the ulna decreased and comfort ($p = 0.003$) and sense of security ($p = 0.004$) increased with the anatomic cuff compared to the previously used conventional cuff. Similarly, physical functioning ($p = .021$), role physical ($p = .005$), bodily pain ($p = .005$) and general health ($p = .012$) measured using the SF36 survey improved.
Conclusions: The anatomic cuff appears superior to conventional cuffs in terms of reduced pain and increased comfort at the forearm. This result is clinically relevant for short and long term users of forearm crutches to reduce discomfort and complications.

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Establishment of an orthotopic tumor model using osteosarcoma HUO9 cells with different tumorigenic properties

Knut Husmann/CH; Sander Botter/CH; Matthias Arlt/CH; Else-Marie Pedersen/CH; Walter Born/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Mice have been used as model organisms in cancer research for a long time, providing significant advances in our understanding of this heterogeneous family of diseases. Two types of human xenograft mouse models (heterotopic and orthotopic), which are defined by the location of the implanted xenograft, are mainly used for cancer research. Orthotopic tumor xenograft mouse models are emerging as the preference for in vivo experiments due to increased clinical relevance over subcutaneous or intravenous mouse models. The major aim of this study was to evaluate if the functional properties of three different human osteosarcoma (OS) cell lines in an orthotopic mouse model were comparable to the results found in heterotopic models.
Methods: Human HUO9, HUO9-L6 and HUO9-M132 OS cell lines were transduced with the lacZ gene by retroviral infection. 2X10E5 tumor cells were orthotopically injected into the tibia of SCID mice. The size of the leg (length and width) was measured using a caliper ruler. Tumor growth and osteolysis in the bone were visualized by conventional X-ray. Bone mass was quantified by microCT measurements. Isolated organs were stained in X-Gal solution and analyzed for metastases formation.
Results: After orthotopic injection of the different HUO9 cell lines, primary tumor growth was first detected in the HUO9-M132 group, followed by the HUO9-L6 group and then the HUO9 group. We could show by X-ray and microCT imaging that all three cell lines exhibited osteoblastic characteristics for primary tumor formation. Quantification of the microCT images showed that the tumor associated bone structures were significantly larger in the HUO9-L6 group, compared to the other two groups. In the HUO9 group, only micrometastases were found in the lung. In the HUO9-M132 group, a large number of micrometastases and several macrometastases were visible on the lung surface. The number of micrometastases in the HUO9-L6 group was similar to that found for the HUO9 group, but macrometastases with a diameter of more than 1 mm were observed.
Conclusions: Orthotopic injection of the three different HUO9 cell lines resulted in primary tumor growth and lung metastases formation different from those observed with heterotopic subcutaneous tumor cell injection. Our results indicate that the anatomic location of tumor cell injection strongly influences the development of primary tumors and lung metastases.

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Chemotherapy revived – intraarterial cisplatin-based chemotherapy in an osteosarcoma xenograft model

Bernhard Robl/CH; Sander Botter/CH; Matthias Arlt/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Osteosarcoma (OS) patients have five-year-survival rates (5-ysr) of approximately 60% receiving standard systemic intravenous (IV) application of cytotoxic drugs such as cisplatin (CDDP). However, intraarterial (IA) chemotherapy can potentially improve treatment efficacy. Although clinical trials performed earlier failed to show a clear benefit, some studies using IA CDDP demonstrated 5-ysr of >80%. Therefore we evaluate IA chemotherapy under controlled experimental conditions.
Methods: Intratibial OSs were induced in SCID mice using 143B cells. After tumor establishment (determined by caliper), CDDP (at 4 mg/kg) or vehicle (0.9% NaCl) was administered IV (tail vein) or IA (arteria femoralis). Infusion was performed using custom-made polyethylene catheters and a syringe pump. During the treatment period, blood flows and body weights (BW) were monitored. Post mortem, kidney damage and numbers of metastases were assessed.
Results: IA CDDP yielded the largest reduction of tumor volume measured by caliper (87 ± 20%; mean ± SEM % of initial tumor volume) compared to IV CDDP (251 ± 18%), IA NaCl (340 ± 76%) or IV NaCl (426 ± 36%). Furthermore, neither significant loss of BW, nor a significant reduction in blood flow of the tumor leg CDDP-specific kidney damage was observed. In addition to tumor volume reduction, IA CDDP significantly reduced the number of micrometastases (IA CDDP: 68 ± 42 (mean ± SEM); IV CDDP: 200 ± 15; IA NaCl: 680 ± 296; IV NaCl: 212 ± 41) as well as the number of macrometastases.
Conclusion: IA infusion of CDDP shows superior efficiency in treating OS xenografts, without increasing kidney damage or loss of BW. Despite being technically challenging, this route of administration should thus be reconsidered for clinical application.

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Sarcoma patient derived tumor cells obtained by the explant technique

Roman Muff/CH; Sander Botter/CH; Knut Husmann/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Sarcoma is a heterogeneous group of cancers that arise from mesenchymal cells and thus affect soft tissues as well as the bones. The WHO distinguishes 29 entities that are further subdivided into more than 200 sub-entities. Furthermore, sarcoma is a rare disease. Therefore, the research in sarcoma is often hampered by limited amount of available tumor tissue especially from initial biopsies. To overcome this, in vitro cell culture and/or expansion of the material in mice as patient derived xenografts (PDX) can be envisaged. Here we have used the explant culture technique to address its utility to expand tumor cells in vitro and to test whether frozen tissue is still viable to be used in PDX.
Methods: Tumor material (total 493 samples) was obtained from initial biopsy and/or during resection of patients with sarcoma. Tumor material was cut into pieces of <5 mm and were put in cell culture flasks for direct explant culture, or put in freezing medium and gradually frozen for later use in explant culture. Outgrowing cells were detached by trypsinization and reseeded in the same flask for expansion to confluence. Cells were then detached by trypsinization and frozen gradually but with final storage in liquid nitrogen. Cancer cells were identified by abnormal karyotypes using conventional G-banding.
Results: In direct explant culture the overall success rate, defined as explants that yielded enough growing cells for freezing, was 76%. The success rate was higher (81%) in bone compared to soft tissue tumors (68%; $P < 0.001$). There, the undifferentiated and adipocytic sarcoma showed the lowest success rates of 47% and 59%, respectively. In

bone tumors, success rates were high in chondrogenic tumors (73%), osteogenic tumors (91%) and Ewing sarcoma (94%). In osteogenic sarcoma the success rate was also high (64%) in tissue, that was frozen to –78°C before explant culture, but 27% lower (P <0.003) than after direct explant culture. From eight osteosarcoma patients the biopsy and/or resection derived cells were subjected to karyotyping. High percentage (43–100%) of cells with abnormal karyotype was seen in five (38%) of the 13 samples in either the biopsy (3/7) and/or the resection (2/6) of four (50%) patients. The other four patients seemed to present normal karyotypes.
Conclusions: Sarcoma patient derived tumor cells are obtained with high success rates by the explant technique. Adequately frozen tumor tissue is still viable and can be used for PDX.

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Targeting αvβ3 and αvβ5 integrins in osteosarcoma cells

Ana Gvozdenovic/CH; Walter Born/CH; Roman Muff/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Osteosarcoma (OS) is the most common primary malignant bone tumor in children and adolescents with a high propensity for metastasis. Patients with metastatic or recurrent disease continue to have a poor prognosis, with a 5-year survival rate of 10–20%. Survival of patients with localized disease has reached a plateau of 60–70% twenty years ago. Hence, development of novel treatment strategies including targeted therapy that would improve survival rates are of essential relevance. Integrins are a large family of cell surface adhesion glycoproteins that bind the components of the extracellular matrix and play a pivotal role in cell attachment, motility, proliferation and tumor cell metastasis. Interestingly, αvβ3 is associated with the metastatic potential and migratory and chemotactic properties of human osteosarcoma cells. Therefore, we evaluated Cilengitide (EMD 121974), a small cyclic RGD-containing pentapeptide that selectively inhibits αvβ3 and αvβ5 integrins, as a novel therapeutic agent against OS. We investigated its in vitro effects in human OS U2OS cell line.
Methods: Cell surface expression of αvβ3 and αvβ5 integrins was assessed by FACS. WST-1 viability assay was employed in order to study the cytotoxicity of Cilengitide. Apoptosis was examined by Western blot analysis of PARP cleavage. The effects of Cilengitide on adhesive and migratory properties of OS cells essential for their metastatic behavior were investigated in in vitro functional assays, namely adhesion and wound healing assays.
Results: Cilengitide treatment in αvβ3 and αvβ5 integrin expressing U2OS cells induced a dose-dependent decrease in cell viability compared to untreated control with the half-maximal inhibitory concentration (IC50) of of 2.7 µg/ml. Apoptosis caused by Cilengitide was caspase-independent. Cilengitide inhibited de novo adhesion to vitronectin in a dose-dependent manner (IC50 = 1.7 ng/ml). On the other hand, Cilengitide induced a dose-dependent detachment of cells fully attached to vitronectin-coated culture flasks (IC50 = 3 µg/ml). Furthermore, cilengitide treatment inhibited migration of U2OS cells up to 63% when compared to cells left untreated.
Conclusions: Our in vitro experiments showed that Cilengitide decreases cell viability, induces apoptosis, inhibits adhesion and migration of OS cells, implicating that this selective antagonist of αvβ3 and αvβ5 integrins is a promising novel drug for primary and metastatic OS.

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Multicolor flow cytometry-based cellular phenotyping identifies osteoprogenitors and inflammatory cells in the osteoarthritic subchondral bone unit

Dr. Benjamin Pippenger, Universitätsspital Basel, Basel/CH; Dr. Ralph Duhr, Universitätsspital Basel, Basel/CH; Dr. Manuele Muraro, Universitätsspital Basel, Basel/CH; PD Dr. Geert Pagenstert, Universitätsspital Basel, Basel/CH; PD Dr. Thomas Hügle, Universitätsspital Basel, Basel/CH;Dr. Jeroen Geurts, Universitätsspital Basel, Basel/CH

Introduction: The cellular component of the subchondral bone unit is thought to be responsible for aberrant bone remodeling in osteoarthritis (OA). Direct phenotypical analysis of the cellular compartment is critical to better understand the OA disease process. This study provides proof-of-principle that cells isolated from the subchondral bone unit can be directly phenotypically characterized by flow cytometry without prior use of cell culture techniques.
Methods: Tibial plateaus were obtained from patients undergoing total knee arthroplasty. Subchondral bone chips were digested with collagenase IA and single cell suspensions were directly phenotyped using flow cytometry. Cells were analyzed for the expression of alkaline phosphatase (ALP) as osteoblast/osteoprogenitor marker and monocyte/macrophage markers (CD14, CD68, HLA-DR, CD115).
Results: Collagenase digestion efficiently released fat tissue and marrow and bone-lining cells, evidenced by a strongly decreased MTT staining. Within the CD45-negative fraction the large majority of cells (>70%) expressed the mature osteoblast marker OC and approximately twenty percent of the cells were positive for the early osteoblast/osteoprogenitor ALP. The relative percentage of mature osteoblasts (CD45-/OC+) was slightly increased in sclerotic (64.2 ± 10.3%) compared with nonsclerotic (50.5 ± 12.5%) marrow tissues. Within the hematopoietic cell fraction, several distinct cell populations could be discriminated. The vast majority of cells were of monocytic origin (~80%) displaying strong surface expression of CD14 with or without co-expression of HLA-DR. In both nonsclerotic and sclerotic subchondral bone tissues, discreet macrophage populations (CD14+/HLA-DR+/CD68+) were identified and the percentage of macrophages was two-fold increased in the latter. Expression of the anti-inflammatory M2 macrophage marker CD163 in monocytic cells was very low (<2%). Putative osteoclast progenitors (CD45+/HLA-DR-/CD14-/CSFR+) were present in both subchondral bone phenotypes.
Conclusions: Flow cytometry analysis of the subchondral bone unit provides a powerful tool in helping to understand the cellular contribution to human OA. Osteoprogenitors/osteoblasts and inflammatory cells reside in bone marrow cavities and their relative abundance changes between subchondral bone phenotypes. These data suggest that osteoimmunological interactions between these populations might be involved in OA bone remodeling.

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Do we really know corrosion phenomenon of COCrMo alloy TKA?

Dr Behrang Allami, Centre Hospitalier Universitaire de Lausanne and University of Lausanne, Lausanne, Switzerland, Lausanne/CH; Dr Xavier Le Duy, Centre Hospitalier Universitaire de Lausanne and University of Lausanne, Lausanne, Switzerland, Lausanne/CH; Dr Anna Igual, École polytechnique fédérale de Lausanne, Lausanne, Switzerland, Lausanne/CH; Dr Stefano Mischler, École polytechnique fédérale de Lausanne, Lausanne, Switzerland, Lausanne/CH; Prof. Dr Brigitte M. Jolles, CHUV, Lausanne/CH

Introduction: The degradation products of orthopedic implants include two basic types of debris: particles and soluble debris. Debris are considered to induce an immune reaction, an aseptic inflammation and there by an early failure of the implant. The implant loosening due to aseptic osteolysis accounts for 75% of total joint arthroplasty failure. The relaxation of debris as metal ions is the consequence of an electrochemical reaction of corrosion between implants and physiological liquids. There is currently a need to assess the in-vivo electrochemical corrosion behaviour of CoCr Mo, biomedical alloys in human synovial fluids in an attempt to identify possible patient or pathology specific effects.
Objectives: The purpose of this study was to measure the electrochemical properties of the synovial fluid extracted from patients with osteoarthritis stage III and IV before a total knee arthroplasty (TKA) and during knee prosthesis revisions, using bovine calf serum as reference measurement.
Methods: Three groups of patients were made and their corresponding fluid extracted after informed and signed consent. In the first group, patients did not have an implant but exhibited different grades of knee inflammation. Synovial fluid was extracted at the beginning of the knee arthroplasty surgery. In the second group, patients had already a TKA implant and synovial was extracted during a joint aspiration performed for another medical reason. In the third group of patients, synovial fluid was extracted when patients underwent a revision surgery. Four different electrochemical tests were carried out sequentially on samples of synovial fluid of all included patients.
Results: Sixteen (16) patients were included in this study. There were eleven (11) patients in first group, three (3) in second group and two (2) in third group. The different electrochemical measurements were carried out in synovial fluid with outstanding precision and signal stability.
Conclusions: A protocol testing knee synovial fluid from patients and transfer to electrochemical lab set-up has been successfully established with precision and signal stability. Corrosion rates appeared to be larger than expected until now. Comparison with bovine calf serum showed different reaction mechanism than the synovial fluid opening the door to new in-vitro methods needed to test knee implants before they are used in vivo.

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Increased subchondral bone loss but lack of cartilage damage in a mouse model of premature aging due to mitochondrial DNA mutations

Dr. Jeroen Geurts, Universitätsspital Basel, Basel/CH; Pascal Distel/CH; Prof. Dr. Magdalena Müller-Gerbl/CH;Prof. Dr. Ulrich A. Walker/CH; PD Dr. Thomas Hügle, Universitätsspital Basel, Basel/CH

Background: Animal models with mitochondrial DNA (mtDNA) mutations undergo premature ageing due to an excess of reactive oxygen species (ROS) and apoptosis. MtDNA dysfunction also occurs in human osteoarthritic chondrocytes. Whilst reduced bone density has been described in mice with mtDNA mutations, it is unclear whether they develop osteoarthritis (OA).
Aim: To assess histologically cartilage and subchondral bone damage of the knee joint along with subchondral osteoclast activity in a mouse model of premature ageing due to the expression of a proofreading-deficient version of the mtDNA polymerase g (POLG).
Methods: 16 mice, of those 7 wildtype (wt), 5 heterocygotous +/D257A and 4 homocygotous D257A/D257A were investigated by histology. OARSI score was applied and osteoclast activity was assessed by TRAP staining.
Results: Compared to the wild type, OARSI of the knee joint was not higher in +/D257A or D257A/D257A mice. Homozygote mice tended to have lower OARSI scores in the femoral compartment. However, both the subchondral bone plate and trabecular bone structure was significantly thinner in D257A/D257A than heterozygote or wt ($p < 0.05$) indicating osteopenia. TRAP activity wassignificantly higher in in D257A/D257A mice.
Conclusion: Increased bone loss and osteoclast activity probably due to ROS accumulation, but no cartilage damage occurs in mice with mtDNA mutations. Osteoclast hyperactivity as occuring in this premature aging mouse model likely requires additional mechanical factors to induce osteoarthritis.

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Fibrin glue does not improve rotator cuff healing in a rat model

Dr. Michael Schär, Orthopädie und Traumatologie, Universität Bern, Bern/CH; PD Dr. Richard Ma, Hospital for Special Surgery, New York City/US; Ashley Titan, Hospital for Special Surgery, New York City/US; Marco Sisto, Hospital for Special Surgery, New York City/US; Will Gu, Hospital for Special Surgery, New York City/US; PD Dr. Matthias Zumstein, Inselspital Bern, Bern/CH; Dr. Xiang-Hua Deng, Hospital for Special Surgery, New York City/US; Prof. Dr. Scott Rodeo, Hospital for Special Surgery, New York City/US

Introduction: Even though surgical techniques have improved the clinical outcome in the last decade, the retear rate of massive rotator cuff tears (RCT) remains high. For this reason, there has been much interest in the biological augmentation of the rotator cuff repair. Fibrin sealant is made out of clotting factors and a fibrinolysis inhibitor and has shown not only to improve the healing of Achilles tendon ruptures, but also has accelerated soft tissue healing by promoting neovascularization and early influx of fibroblasts to the healing site. It furthermore has improved graft incorporation into a bone tunnel. Although these studies are encouraging, it is unclear, if fibrin sealant improves tendon-bone healing in the RCT model. Our hypothesis was that fibrin sealant will improve the healing of the tendon-bone interface in a rat RCT model.
Methods: A total of 30 mature Lewis rats underwent bilateral detachment and acute repair of the supraspinatus tendon by sutures. In each rat the RCT repair in one shoulder was augmented with 50µl of fibrin sealant (Evicel Fibrin Sealant, Ethicon, USA) and in the other shoulder, a repair without fibrin sealant augmentation was performed (control group). Half of the animals were sacrificed after 2 weeks, the other half after 5 weeks. 12 rats per group and time-point were allocated for biomechanical testing and three rats for histological evaluation.
Results: Dissection of the shoulders after euthanization showed continuity between the bone and the tendon in all the specimens with no detectable differences between the two groups. Even though the maximal load to failure as well as the stiffness improved in both groups from 2 to 4 weeks, we did not find significant differences between the fibrin sealant and the control group. At 2 weeks, the mean load to failure for the fibrin sealant group was 8.94 ± 3.27N and for the control group 8.31 ± 2.42N ($p > 0.05$). At 5 weeks, the mean load to failure for the fibrin sealant group was 22.29 ± 6.44N and for the control group 21.05 ± 5.33N ($p > 0.05$). Also no differences were found with respect to the stiffness of the repair construct. No significant differences were found between the groups at each time point with respect to the new cartilage formation and collagen organization in histological evaluation.
Conclusion: Adding fibrin sealant to the healing rotator cuff repair did neither improve the structure nor the biomechanical properties of the tendon-bone junction in a rat model.

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Prospective isolation of perivascular stem cells for the treatment of critical size bone injuries

Dr. Matthias König, UniversitätsSpital Zürich, Zürich/CH; PD Dr. Dieter Cadosch, UniversitätsSpital Zürich/CH; Prof. Dr. Clément Werner, UniversitätsSpital Zürich, Zürich/CH; Prof. Dr. Hans-Peter Simmen, UniversitätsSpital Zürich, Zürich/CH; Prof. Dr. Guido Wanner, Universitätsspital Zürich/CH; PD Dr. Paolo Cinelli, UniversitätsSpital Zürich/CH

Objective: Multipotent mesenchymal stem cells (MSCs) can be isolated from different adult tissues and represent an interesting source of cells for therapeutic applications. An interesting subpopulation is represented by the perivascular cells (pericytes), which can be prospectively identified by the expression of CD146, NG2, and PDGF-Rbeta and absence of hematopoietic, endothelial, and myogenic cell markers.
Methods: We isolated CD146+ NG2+ and CD45- cells from adipose tissue from C57BL/6 mice by magnetic activated cell sorting (MACS). Upon seeding on scaffolds these isolated cells were differentiated for two weeks in osteogenic medium. Next, we tested the regenerative capacity of these cells in a mouse model for femoral segmental critical-sized defect. This model is based on a 3.5-mm-long segmental bone defect where the bone is fixed by a titanium microlocking plate. The freshly isolated cells were seeded on a collagenous bone scaffold which upon overnight cultivation in vitro was inserted in the segmental bone gap. A control group with collagenous bone scaffold but without cells was used. Eight weeks upon surgery the bones were isolated and analyzed by micro-computer tomography.
Results: CD146+NG2+CD45-cells directly upon MACS, without further expansion in vitro, were differentiated toward the osteogenic lineage and alizarin red staining was performed after two weeks of differentiation. We could confirm that CD146+ NG2+ CD45- cells are able to generate osteoblasts and induce mineralization with a higher efficiency compared to unsorted ASCs. In a second step cells were seeded on the different scaffolds and cultivated for 5 days. Upon staining with MTT we could observe that the cells were viable and that they mainly colonized the holes present on the scaffolds, as shown by scanning electron microscopy. The freshly isolated cells were seeded on a collagenous bone scaffold which upon overnight cultivation in vitro was inserted in the segmental bone gap. A control group with collagenous bone scaffold but without cells was used. Eight weeks upon surgery the bones were isolated and analyzed by micro-CT scan. Quantificaton of the data indicated that the perivascular stem cells seeded scaffold had a significantly stronger mineralization as compared with the scaffold only controls. Perivascular stem cells isolated from ASCs are able to contribute to bone regeneration and might represent a valuable alternative for improving bone healing in critical size bone injuries.

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Costamere remodeling starts 4 days after tenotomy of the soleus muscle in a rat model: a pilot study

Dr. Florian Wanivenhaus, Universitätsklinik Balgrist, Zürich/CH; Dr. Céline Ferrié, Universitätsklinik Balgrist/CH; Prof. Dr. Martin Flück, Universitätsklinik Balgrist, Zürich/CH

Introduction: Tendon tears induce muscle retraction which is followed by a decrease in fiber mass. Degradation of Z-disks, which hold sarcomeres in register, is a critical event in muscle degeneration because this facilitates disintegration of myofibrils. There is evidence that Z-disk degradation is coupled to the turnover of sarcolemmal sites of focal adhesion (costameres), which anchor Z-disks via the cytoskeleton to the fiber periphery and connect to adjacent muscle fibers. We set out a pilot study to determine whether tendon release affects the expression of costameric proteins in slow type soleus muscle.
Methods: 3-months-old female Wistar rats ($n = 9$) were anesthetized in 3% isoflurane. The distal end of the soleus muscle was exposed in both legs and severed for the right leg (tenotomy) while leaving connective tissue sheets untouched, the left leg serving as mock control. Soleus muscles were harvested immediately, 4 days and 14 days after tenotomy ($n = 3$ per time-point), cryo-sectioned and analyzed by immunohistochemistry for the distribution of slow and fast fiber types, and fibers with signs of damage (internal nuclei). The expression of costameric proteins (meta- and gamma-vinculin) was

assessed with immunoblotting. Statistical significance was assessed with a repeated ANOVA and localized with a post-hoc test of Fisher.
Results: Body weighed-related soleus mass demonstrated a trend ($p = 0.10$) for an increase in mock controls 4 days after tenotomy but was not affected in the severed muscle ($p = 0.50$). Tenotomy increased the percentage of hybrid fibers in the severed muscle versus mock controls after 4 days (11% vs. 2%) and 14 days (26% vs. 11%). The percentage of damaged fibers was transiently increased in mock controls 4 days after tenotomy on the contralateral side. A trend ($p = 0.10$) for a 10-fold increase in meta-vinculin was noted after 14 days of tenotomy in the severed soleus muscle when the mock control demonstrated a trend ($p = 0.08$) for a 2-fold reduction in gamma-vinculin.
Conclusion: These first results imply that muscle fibers demonstrate signs of myofibrillar remodeling 4 days after tenotomy, already, which is followed by altered expression of structural elements of the costamere and which contrasts to compensatory reactions on the mock-operated contralateral side.

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Identification of Fascin-1 as a novel prognostic biomarker in osteosarcoma

Adam Sabile/CH; Walter Born/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Osteosarcoma (OS) is the most common highly malignant primary bone tumor of children and young adults with a high propensity for lung metastasis, the main cause of disease-related death of OS patients. Reliable outcome-predictive biomarkers and targets for OS metastasis suppressing drugs are urgently needed for more effective treatment of metastasizing OS, which has a current mean 5-year survival rate of approximately 20%. In the present study, we aimed at the identification and characterization of novel key effector molecules which might be involved in OS metastasis promoting mechanisms.
Methods: In an effort to identify novel regulatory biomarkers, we used strategies combining immunohistochemistry-based OS tissue microarray/Kaplan-Meier survival analysis and literature search.
Results: We identified Fascin-1 and showed for the first time that its expression is a predictor for a poor outcome of OS patients.
Conclusion: Kaplan-Meier survival analysis of immunohistochemical data obtained from an OS tissue microarray identified Fascin-1, a component of the cytoskeleton, as a predictor for a poor prognosis for osteosarcoma patients. Currently, we are investigating in detail Fascin-1 functions and signaling in the context of OS pathogenesis.

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A comparison of three micro-CT imaging systems for in vivo experimental research in mice

Sander Botter/CH; Gisela Kuhn/CH; Petra Seebeck/CH; Walter Born/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: In osteosarcoma (OS), primary tumors are frequently found in the proximal femur/distal tibia, and metastases are found in lungs and in the skeleton. Computed tomography (CT) is able to visualize the ongoing changes in each of these body parts. In preclinical research, in vivo micro-CT is used to quantify primary tumor and metastasis growth, but because several systems exist on the market, it is unclear if the obtained results are comparable. Therefore, we performed a direct comparison of three often-used high-resolution in vivo micro-computer tomography (micro-CT) systems within Zurich for their ability to image potential OS-affected sites in mice.
Methods: We evaluated micro-CT scans derived from the Skyscan/Bruker 1176 in vivo micro-CT (Balgrist University Hospital), the PerkinElmer Quantum FX (ZIRP) and the Scanco Medical vivaCT 40 (ETH Zürich). In each scanner, lungs, knee joints and whole body scans were performed in a group of six female, age-matched C57Bl/6 mice (three groups in total). The systems were compared with respect to spatial resolution/scan quality, total scan time and radiation burden (Radcal Accu-Dose model 2186).
Results: No differences in body weight were noted between the three mouse groups. In general, all scanners were able to perform scans of the selected body parts, although significant differences were noted in the total scan time (lungs/knee joint: Quantum FX<Skyscan 1176=Scanco vivaCT; whole body: Quantum FX<Skyscan 1176<Scanco vivaCT), spatial resolution (knee joints: Scanco vivaCT > Skyscan 1176 > Quantum FX; lungs: Skyscan 1176 = QuantumFX > Scanco vivaCT; whole body: Quantum FX=Skyscan 1176, Scanco vivaCT n.a.) and dosimetry (Quantum FX<Scanco vivaCT<Skyscan 1176).
Conclusions: All three systems are capable of monitoring OS prone body sites in mice. We found that the QuantumFX is the fastest system, but had the lowest spatial resolution, where the opposite was true for the Scanco vivaCT system. The Skyscan 1176 can be placed in between these systems, combining a relative high spatial resolution with speed, which for the specific purpose of osteosarcoma imaging is beneficial.

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Metastasis suppression via interruption of the CXCR4/SDF-1 chemokine axis in osteosarcoma

Olga Neklyudova/CH; Matthias Arlt/CH; Patrick Brennecke/CH; Walter Born/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: The CXCR4/SDF-1 chemokine axis has an important role in the metastatic process of many cancers, including osteosarcoma (OS). Consequently, it is an attractive therapeutic target. In the present study, this axis was disrupted by overexpression of a P2G mutant of SDF-1 or of intracellularly retained SDF-1 intrakine (IK) in 143-B OS cells. Effects on intratibial tumor growth and lung metastasis were assessed in SCID mice.
Methods: Control and manipulated LacZ gene expressing 143-B OS cells were injected intratibially. Primary tumor growth was monitored by X-ray imaging and calliper measurements. Lung metastases were visualized by ex-vivo X-gal staining.
Results: Disruption of the CXCR4/SDF-1 axis in 143-B OS cells accelerated primary tumor growth and significantly reduced lung micro-metastasis. This is consistent with a reduced transmigration capacity towards an SDF-1 gradient in vitro of P2G or IK overexpressing tumor cells compared to control. Interestingly, overexpression of SDF-1 in 143-B OS cells enhanced the in vivo lung micrometastatic activity.
Conclusion: Overexpression of P2G or IK in 143-B OS cells significantly diminished lung micro-metastasis in mice. Interestingly, the number of micrometastases correlated inversely with intratibial primary tumor size, suggesting that disruption of the CXCR4/SDF-1 axis inhibited metastatic spread of tumor cells from primary tumors, which consequently contributed to intratibial tumor growth. Conversely, control overexpression of SDF-1 in 143-B OS cells enhanced metastatic spread of these cells compared to non-manipulated cells to the lung and diminished intratibial primary tumor growth. Overexpression of SDF-1 in 143-B cells presumably promoted survival and extravasation of metastasizing cells, but also attracted tumour cell attacking NK cells to the primary tumor. The results of the present study open the door to a CXCR4/SDF-1 axis targeting local lung metastasis suppressive treatment in experimental OS, which may pave the way to a potentially promising novel strategy for the treatment of metastasizing OS.

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Sunitinib malate inhibits tumor growth and lung metastasis in an intratibial mouse model of osteosarcoma

Ram Kumar/CH; Matthias Arlt/CH; Bernhard Robl/CH; Olga Neklyudova/CH; Aleksandar Kuzmanov/CH; Walter Born/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Osteosarcoma (OS) is the most common type of primary bone cancer. It arises in bone during periods of rapid growth and primarily affects adolescents and young adults. Sunitinib malate is a small molecule tyrosine kinase inhibitor (TKI) that is able to pass cell membrane and has been shown to have inhibitory activity against broad spectrum of kinases. The principal aim of the study was to evaluate the effect of sunitinib malate as a therapeutic drug on inhibiting tumor growth of OS and spontaneous lung metastasis.
Methods: 143B-lacZ-mcherry (143-B/LZ+mC) tagged cells were injected orthotopically into the medulla of the left tibia of the mice. Sunitinib was administered daily at 40 mg/kg and 80 mg/kg and carboxymethyl cellulose solution as control. Osteolytic lesions, characteristic for 143-B cell-derived tumors, were recognized by X-ray and bioluminescence in the tibia by IVIS. Metastatic lesions on lung surfaces at sacrifice were detected by X-gal staining. Expression of CD31 positive cells were performed by immunocytochemistry in xenografts.
Results: Osteolysis was less extensive in those mice treated with 80 mg/kg compared with the ones treated with 40 mg/kg, which was moderately extensive, and control mice. At the end of the experiment the mean tumor volume in control animals was $126.9 \pm 73.1\ mm^3$ while those mice which received 40 and 80 mg/kg was $50.30 \pm 36.63 mm^3$ and $39.46 \pm 20.23\ mm^3$, respectively. Oral administration of

sunitinib malate, at 80 mg/kg, daily for 11 days resulted in a significant lower body weight compared to 40 mg/kg treated and the control mice group. Metastatic lesions on lung surfaces at sacrifice were detected by X-gal staining. Micrometastases (diameter <0.1 mm) were found on the lungs of the control mice injected with 143-B/LZ+mC at a mean number of 374 ± 63.8 micro metastases per lung while in 40 and 80 mg/kg sunitinib treated mice, the mean numbers were 118.1 ± 35.83 and 35 ± 11.7 respectively. The number of macrometastases (diameter >0.1 mm) was significantly higher at a mean number of 40 ± 4.5 in control mice when compared to macrometastasis for 40 mg/kg (10 ± 4.5) and 80 mg/kg (3 ± 6.7) sunitinib treated mice.
Conclusions: Here, we demonstrate that Sunitinib malate effectively reduced OS tumor growth and subsequent lung metastasis in an intratibial mouse model of osteosarcoma. The findings reported here could pave way for the clinical trials aimed at innovative therapeutic strategies for the treatment of highly metastatic OS.

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Prospects of 3-D printing in orthopedics

Dr Darius Marti, HFR Fribourg – Hôpital Cantonal, Cressier/CH; Prof. Dr Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH; Lima Sottaz, Universität Basel, Villars-sur-Glâne/CH

Introduction: Three-dimensional printing (3DP) also known as rapid prototyping or additive manufacturing is a revolutionary tool with a wide range of applications. 3DP has become reasonably affordable and is well documented in the literature. We explore the potential uses of 3DP in orthopedic surgery.
Methods: We thoroughly reviewed the current publications about the use of 3DP in orthopedic surgery and compared the different applications that are relevant to a clinical practice with a discussion about its prospects.
Results: 3DP has been tested in orthopedics especially in preoperative planning. In traumatology, a life size pelvis with an acetabular fracture has allowed a precise preoperative planning in this complex surgery and a 3D plastic fractured clavicle model has been used to custom bend a locking plate for a minimally invasive osteosynthesis. The technique has also been used to create a patient-specific screw guiding method for pedicle screw fixation in the thoracic spine. Additionally, modeling complex deformities allows the production of multiple copies to practice on preoperatively. Furthermore, 3DP plays a major role in tissue engineering involving bone substitutes and scaffolds. 3DP can produce osteogenic scaffolds, sometimes embedded with stem cells or growth factors. Studies showed that 3D-printed scaffolds have enhanced mechanical strengths combined with a porous structure allowing bone-forming bioactivity. 3DP enables to organize the cells and the matrix with a specific internal architecture that favors oxygen supply and vascularization. It can also reduce animal experimentation by providing bone models. A 3D-printed drug-delivering device has been tested for bone tuberculosis therapy in rabbits. Custom-made implants and molds have also been described in the literature. Printed molds are especially useful to manufacture implants with a porous surface to enhance the attachment of uncemented prostheses. Surface texturing processes have several disadvantages that are not seen when using printed ceramic molds, shortening therefore the production process.
Conclusion: 3D printing is an attractive technique to improve patient care in creating customized solutions in a vast field of applications, including preoperative planning, tissue engineering and custom-made implants and molds. Nonetheless, prospective clinical studies have yet to be undertaken and these new concepts must be developed on a clinically relevant scale.

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Inhibition of novel molecular targets of the bone microenvironment in osteosarcoma

Dr. Daniela Meyer, Zürich/CH; Sander Botter/CH; Ana Gvozdenovic/CH; Dr. Marco Germann, Universitätsklinik Balgrist, Zürich/CH; Melina Daans/CH; Prof. Dr. Bruno Fuchs, Universitätsklinik Balgrist, Zürich/CH

Introduction: Current therapies for osteosarcoma (OS) have not been able to overcome the existing plateaued survival. One of the reasons may be that no common therapeutic target has yet been found. Therefore, this study concentrates on a common factor in all OS, the bone and its microenvironment. In OS the balanced bone remodelling of healthy bone is disturbed, and the resulting vicious cycle enables the tumor to create its own microenvironment, to grow and spread. Activin A has been shown to be involved in bone remodelling and tumor growth. Therefore newly developed inhibitors against activin A, a Follistatin analogue (FST315-hFcΔHBS) and an activin decoy receptor (ActrIIA-mFc) were tested as novel therapeutics to inhibit OS-associated bone remodelling and thereby, tumor growth.
Methods: in vitro- activin expression was shown in OS cell lines and tumor tissue by ELISA, real-time PCR and Western Blot (WB). Functional activin signaling and its inhibition with FST315-hFcΔHBS and ActrIIA-mFc are illustrated by WB. Osteolytic effects were measured by bone resorption assay. in vivo- local i.t. tumor formation was induced by injection of human 143B OS cells in SCID mice. Current therapy against OS-associated bone remodelling includes zoledronic acid (ZOL) which was used as positive control. Mice were i.p. injected with a vehicle, FST315-hFcΔHBS, ActrIIA-mFc, or ZOL. Tumor volume change was measured by caliper, tumor associated bone remodeling was followed by X-ray and µCT.
Results: OS cells show a functional Activin A expression on RNA and protein levels. Both inhibitors are effectively inhibiting the activin induced signaling. In vivo results show a significant reduction of tumor growth in all treated groups (FST315-hFcΔHBS –56%, ActrIIA-mFc –47%, ZOL –55%, compared to vehicle treated). The activin inhibitors efficiently reduced tumor associated osteolysis (approx. 25% higher bone volume compared to vehicle), with ZOL being the most efficient inhibitor of osteolysis.
Conclusion: The so called "vicious cycle", previously proposed to play a role in other bone-homing tumors also plays an important role in osteosarcoma. This study shows that activin inhibitors and bisphosphonates could successfully disturb the microenvironment, leading to a significant reduction in tumor growth and tumor associated bone remodelling. As these two classes of compounds modulate different pathways in the bone remodelling process, our next aim will be to perform a combination treatment.

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Stem cells versus platelet-augmented Achilles tendon repair – a randomized, active-controlled large animal study

Dr. Patrick Vavken, Children's Hospital Boston, Harvard Medical School, Boston/US; Dr. Benedikt Proffen, Children's Hospital Boston, Harvard Medical School/US; Prof. Dr. Dr. med. Victor Valderrabano, Universitätsspital Basel, Basel/CH; Prof. Dr. Martha Murray, Boston Children's Hospital/US

Introduction: Our hypothesis was that bone marrow concentrate (BMC)-enhanced Achilles tendon repair produces better histological and biomechanical outcomes than platelet (PRP)-enhanced Achilles tendon repair in an adult rabbit model using standard Achilles tendon repair and conservatively treated Achilles tendon transections as active controls.
Methods: 24 New Zealand white rabbits underwent Achilles transection followed by surgical repair, surgical repair with PRP, surgical repair with BMC, or nonsurgical treatment with equinus casting (n = 6 each). Animals were sacrificed at 4 weeks and the Achilles tendon was tested morphologically, biomechanically, and histologically.
Results: Gross assessment showed well-healed defects in all 4 groups, with no differences in surface area across groups (p = 0.234). The histological assessment showed the highest scores among the treatment groups for BMC with 19 points (95%CI 16 to 21) compared to 16 points (95%CI 14 to 18) for PRP (p = 0.345), 13 points for repair (95%CI 10% to 17%) and 7 points for cast treatment (95%CI 6 to 8). However, there were two calcifications in the BMC group. Platelet-enhanced Achilles repair resulted in the best biomechanical outcome with 101% (95%CI 68% to 134%) maximum load and 84% (42% and 126%) yield load compared to bone-marrow enhanced repair with 84% (95%CI 54% to 114%) and 65% (95%CI 54% to 77%). Nonsurgical treatment resulted in the lowest biomechanical result with 57% (95%CI 50% to 64%) and 68% (95%CI 51% to 86%) for maximum load and yield load.
Conclusions: In this study PRP lead to the best biomechanical outcome with good histological tissue quality. Our findings suggest that bone-marrow enhancement can lead to an overstimulated tissue response, resulting in poor histological differentiation, poor biomechanics, and, most importantly, potentially severe complications such as intralesional calcification. We suggest that a high number of mesenchymal cells is the main reason for this overstimulation and we suggest assessment, documentation, and adjustment of this variable in future trials.

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Predicted muscle recruitment depends on the critical shoulder angle – first insights using standard numerical algorithms for muscle recruitment

Elias Bachmann, University of Zürich and ETH Zürich, Zürich/CH; Dr. Arnd Viehöfer, Universitätsklinik Balgrist, Zürich/CH; Prof. Dr. Jess Gerrit Snedeker, Balgrist University Hospital, Zurich/CH; Prof. Dr. med. Christian Gerber, Universitätsklinik Balgrist, Zürich/CH

Introduction: The critical shoulder angle (CSA) represents length and inclination of the acromion relative to the glenoid plane on anteroposterior radiographs. Shoulders with chronic rotator cuff tears (RCT) have significantly larger CSAs than disease-free shoulders. Biomechanical studies have predicted adverse joint reaction forces (JRF) with abnormal CSA values, but how this depends on glenohumeral (GH) joint muscle recruitment is unknown. This study analyzed muscle recruitment as predicted by standard analytical models with variable CSA.
Material / Methods: A validated, adapted, open source rigid-body-shoulder-model tested recruitment of 50 individual muscle segments using the gold-standard algorithm during glenohumeral abduction. Shear and compression JRF assessed the resulting joint stability.
Results: Modifying CSA across pathophysiological ranges (28–38°) had smaller than expected effects on predicted abductor activity. CSA influenced predicted rotator cuff muscle activity (Δmax = 8.8%;15.7N), as did varying muscle recruitment cost function (Δmax = 12.1%; 21.5N). GH-JRFs were also affected but not as predicted by biomechanical analyses including co-contraction.
Discussion: Predicted recruitment of GH abductor muscles was heavily affected by CSA. Comparison with experimental models highlights that consideration of antagonistic muscle co-contraction is potentially critical, although this feature is absent in all widely used rigid body shoulder models.
Conclusion: This is the first study to describe how CSA changes affect muscle recruitment using standard analytical simulation of GH abduction. The effects of CSA changes on GH-JRF substantially depend on associated antagonistic muscle contraction. This implies that development of rotator cuff tearing in patients with large CSA is also influenced by potentially modifiable muscle recruitment patterns.

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Changes in serum COMP and HS-CRP concentrations depend on marathon performance but not on BMI

PD Dr. Annegret Mündermann, University Hospital Basel, Basel/CH; Dr. Jeroen Geurts, Universitätsspital Basel, Basel/CH; Dr. Thomas Nickel/DE; Prof. Dr. Arno Schmidt-Trucksäss/CH; Prof. Dr. Martin Halle/DE;PD Dr. Henner Hanssen/CH

Introduction: In recent years, marathon running has attracted participants with diverse athletic backgrounds and different body compositions ranging from lean to obese participants. Potential negative effects of such physical stress on musculoskeletal tissue is concerning in obese persons who are at higher risk for knee osteoarthritis. Load-induced changes in biomarkers such as cartilage oligomeric matrix protein (COMP) may reflect changes in tissue metabolism that may be mediated by inflammatory responses. Some markers of inflammation such as high-sensitivity C-reactive protein (hsCRP) also respond to prolonged exercise [1]. The objective of this study was to test if changes in serum COMP and HS-CRP concentration in response to marathon running depend on body stature or on marathon performance.
Methods: Serum biomarker concentrations immediately before and after and 24h after a marathon race were determined in 45 subjects using commercially available ELISA kits and analyzed using repeated measures ANOVA with covariates BMI and finish time ($P < .05$).
Results: Increases in COMP and hsCRP 24h after the marathon depended on finishing time but not BMI. BMI ranged from 17.0 to 36.5 kg/m^2 and finish time from 2'56" to 5'32". Participants in the slower finish time tertile had the largest increases in COMP and hsCRP in the 24h after the marathon, while in participants in the middle and fast finish time tertile COMP decreased and the increases in hsCRP were smaller in the 24h after the marathon. Although BMI did not significantly influence changes in biomarker levels, BMI was significantly greater in the slowest than in the middle and fastest tertile ($P < .001$).
Conclusion: Finishing time appears to be a stronger predictor of these biomarker changes during the 24h post-marathon recovery than BMI. Finishing time related changes may represent differences in post-stress tissue metabolism. The increase in COMP and hsCRP levels after marathon may suggest a role of inflammatory processes in stress-induced cartilage metabolism during recovery.

References [1] Nickel et al. (2012) Eur J Appl Physiol 112:1699:1708.

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Does the level of health care insurance affect the outcome of 6,595 trauma patients?

Dr. Thorsten Jentzsch, Universitätsklinik Balgrist, Zürich/CH; PD Dr. Valentin Neuhaus, UniversitätsSpital Zürich, Zürich/CH; Prof. Dr. Burkhardt Seifert, Universität Zürich, Zürich/CH; Dr. Georg Osterhoff, UniversitätsSpital Zürich, Zürich/CH; Prof. Dr. Hans-Peter Simmen, UniversitätsSpital Zürich, Zürich/CH; Prof. Dr. Clément Werner, UniversitätsSpital Zürich, Zürich/CH; Dr. Rudolf Moos, UniversitätsSpital Zürich, Zürich/CH

Introduction: According to studies from the United States, uninsured patients are at increased risk of higher mortalities. In a European country like Switzerland, where health insurance is compulsory and insurance coverage rates are much higher, however, differences may be found in varying levels of health insurance. Although publicly-insured patients seem to have a higher complication risk for elective surgeries, traumatic injuries usually require immediate attention without knowing any patient information, so the influence of the insurance status is questionable. The aim of our study was to examine the impact of public versus (vs.) private health care insurance on the epidemiology of injuries, mortality and surgeries in a large sample of trauma patients.
Methods: A retrospective cohort study of consecutive patients was performed in 2012 and 2013 at a level one trauma center*. The level of health insurance was determined as public vs. private extended and a comparison of these groups was performed for various epidemiological variables including the type of injuries, outcome, and surgeries. Statistical analysis included the chi-square, Fisher's exact, Mann-Whitney tests as well as linear, binary and multinomial logistic regression analysis to adjust for age and sex. P-values <0.005 were considered statistically significant.
Results: Of the 6,595 patients, 25% were privately insured. Most studied variables did not show differences between publicly and privately insured patients. Private insurance was associated with significantly longer hospital stay, discharge to a rehabilitation clinic, fractures of the proximal humerus, and shoulder dislocations, while public insurance was significantly associated with young age, males, transfer to another hospital / mental institution, head concussions / fractures, and higher mortality.
Conclusion: In a country with compulsory health care coverage and in a trauma setting, the level of insurance seems to be negligible for most types of injuries and surgeries. However, on the one hand, private insurance may be associated with longer hospital stays, more transfers to rehabilitation clinics, and fractures of the proximal humerus, while public insurance, on the other hand, may be associated with younger male patients, transfers to another hospital, head trauma, and increased mortality.

Reference: *[Authors of this abstract]: The impact of public vs. private insurance on trauma patients. Manuscript submitted for publication.

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Burn out among the orthopaedic surgeons in Switzerland

Dr Anne Garcia, Martigny/CH; Dr Sylvain Steinmetz, Martigny/CH; Dr Krzysztof Piasecki, Martigny/CH; Dr Philippe Zermatten, Martigny/CH; Dr Yvan Arlettaz, Martigny/CH

Introduction: Who doesn't know someone suffering from burnout? It is defined as a state of physical, emotional or mental exhaustion caused by long-term involvement in situations that are emotionally demanding, in the meaning of working stress. A key point here is it had been proved to be closely linked with the social aspect of the job. We propose here an investigation of the prevalence of burnout among 152 orthopaedic surgeons in Switzerland, and an evaluation of protecting and predisposing factors.
Methods: This study consists on mailing to advanced residents and all senior orthopaedic surgeons of the country 2 questionnaires. The first is the MBI (Maslach Burnout Inventory), assessing the degree of burnout among our population. This questionnaire is composed of 22 questions divided according to the 3 components of the burnout: emotional exhaustion (EE), depersonalisation (DP) and the feeling of low personal accomplishment (LPA). The second questionnaire is composed of 40 additional questions regarding predictory or protecting factors of burnout based on professional and personal criteria.
Results: In our population, we determine 23.68% of high degree of burnout in the EE dimension, 27.63% in the DP and 42.76% in the PA dimension. We found similar prevalence of high burnout in german and french speaking populations regarding EE and DP, but a significant difference is observed in the LPA score. The most prominent protecting

factors regarding personal life are: age over 50, practice of sports and having relationships out of work. Having more than 2 children seems to affect positively the DP dimension. Concerning the working environment, it appears that an atmosphere of collaboration and the feeling of being valorized are the major protecting factors. So that we can observe a rise in the scores in EE and DP for surgeons living in an environment felt as competitive. An important predisposing factor is the pressure felt by the administration and patients that raises the risk of EE and DP: with as much as 5.55 additional points in EE score.
Conclusion: Our population of swiss orthopaedic surgeons is prone to burnout, especially in all 3 components. We know that it is a profession exposed to a lot of pressures and submitted to a duty of efficiency and reliability that submits them to stress, and we assessed that when they don't find a way to relieve it or to have a life aside of the hospital, they tend to fall into burnout.

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Responsiveness and ceiling effects of the Oxford Hip Score and the Forgotten Joint Score – 12 in patients after total hip arthroplasty

Dr. Pascal Gerhard, Kantonsspital St. Gallen, St. Gallen/CH; Dr. Johannes Giesinger/AT; Dr. David Hamilton/GB; Dr. Colin Howie/GB;Dr. Nico Seiler/CH; Dr. Karlmeinrad Giesinger, Kantonsspital St. Gallen, St. Gallen/CH

Introduction: Patient-reported outcomes (PROs) are a key parameter for assessing outcome following total hip arthroplasty in both clinical studies as well as in national joint registries. Emerging literature shows that PRO questionnaires differ substantially in their ability to capture change following joint replacement surgery. When designing clinical outcome studies, the responsiveness of a score is of key importance in determining which PRO measure should be used as this will materially affect the required sample size. The objective of our study was to assess the sensitivity to change over time and potential ceiling effects of the Oxford Hip Score (OHS) and the Forgotten Joint Score – 12 (FJS-12) in patients 6 and 12 months after primary total hip arthroplasty (THA).
Methods: Patients undergoing total hip arthroplasty in a 6 month period (January to June 2013, New Royal Infirmary, Edinburgh) were assessed 6 and 12 months post-surgery using the OHS and the FJS-12. Responsiveness was analysed by calculating effect sizes (Cohen's d) for measured change. Ceiling effects were described with percentages of patients reaching the highest possible score on the questionnaires.
Results: Data from 234 patients were available for analysis (59.8% female; mean age 67.2, SD 11.5). Mean OHS improved from 40.1 (SD 8.0) at 6 months to 40.9 (SD 7.3) at 12 months. Mean FJS-12 improved from 56.3 (SD 30.4) at 6 months to 61.2 (SD 29.3) at 12 months. Effect size of change was 0.10 for the OHS and 0.16 for the FJS-12. This means that detecting statistically significant change (in a t-test for dependent samples; alpha = 0.05; power = 0.80) between 6 and 12 months requires a sample size of n = 788 for the OHS and n = 309 for the FJS-12. 20.7% of patients reached the highest score in the OHS and 10.9% of patients reached the highest score in the FJS-12 at 12-month follow-up. At 12 months ceiling effect was 20.7% for the OHS and 10.9% for the FJS-12. 48.6% (OHS) vs. 22.2% (FJS-12) of patients scored within the top 10% of the score ranges.
Conclusions: Our findings suggest that the FJS-12 is more responsive to change between 6 and 12 months after THA than the OHS. The measured ceiling effect for the OHS was twice that of the FJS-12. The difference in effect size of change results in substantial differences in required sample size if aiming to detect change between these two time points. This has important implications for powering clinical trails with PRO tools as the primary outcome.

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Search for a standard for the documentation and evaluation of surgical complications after shoulder arthroplasty and arthroscopic rotator cuff tear reconstruction

PD Dr. Laurent Audigé, Schulthess Clinic, Zürich/CH; PD Dr. Andreas Marc Mueller/CH; Dr. Matthias Flury, Schulthessklinik Zuerich, Zürich/CH; Dr. Hans-Kaspar Schwyzer/CH; Raphael Blum/CH; Dr. Matthijs Jacxsens, Universitätsspital Basel, Basel/CH; Theodore Walz/CH;Dr. Holger Durchholz/CH

Introduction: Valid comparison of outcomes of surgical procedures requires consensus on which instruments and parameters should be used, including the recording and evaluation of complications. An international standard for the terminology and definitions of surgical complications in orthopaedics is lacking. The aim of our project is to define a minimum complication list ("core set") and evaluation form to be applied after arthroscopic rotator cuff repair (ARCR) and shoulder arthroplasty (SA). We present the current progress and results of these projects.
Material & Methods: Two independent systematic literature reviews were implemented as the basis for an international consensus process. We searched PubMed for a general definition of complications in surgery. In parallel, PubMed, EMBASE, Cochrane Library and Scopus databases were searched for reviews, clinical studies and case reports of complications focusing on ARCR or SA. The terminology of complications and their definitions were extracted from selected articles by two reviewers. Within the ARCR project, an organized list of relevant complications was reviewed by an international panel of clinical experts in a Delphi process. Consensus was defined as at least a two-third agreement for each complication or group of complications including definition, specification and timing of occurrence. A similar process will be implemented for SA complications.
Results: We extracted 242 terms for local complications after ARCR from 255 original papers. There were multiple terms/definitions to describe specific events, e.g. 16 for "shoulder stiffness". An initial list was evaluated by 72 experts. Consensus could be partly achieved, but not regarding the time frame of postoperative occurrence. It is also not clear whether "non-local" complications should be included in the "core set". For the SA project, the database search yielded 853 references; the first 212 selected full texts were reviewed. Different definitions were used for similar terms such as implant loosening (n = 33).
Conclusion: The literature does not consistently report on surgical complications after ARCR or SA, making valid comparison of the incidence of complications after these interventions problematic. Our work serves as the basis for developing a uniform documentation process of complications and the standardization of complication definitions in ARCR and SA.

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Preliminary cost-utility data about common orthopedic procedures on the upper extremity

Cécile Grobet, Schulthess Klinik, Zürich/CH; Dr. Matthias Flury, Schulthessklinik Zuerich, Zürich/CH; Dr. Michael C. Glanzmann, Schulthess Klinik, Zürich/CH; Dr. Daniel Herren, Schulthess Klinik, Zürich/CH; Sascha Hess, Zurich University of Applied Sciences, Winterthur/CH; PD Dr. Laurent Audigé, Schulthess Clinic, Zürich/CH

Introduction: Orthopedic procedures can have relevant impact on patient quality of life (QOL) as well as return to work rates, and are often associated with high medical costs. For upper extremity procedures, the impact on patient benefits and costs in Swiss routine care is poorly documented. In this study, gain in QOL and joint function after arthroscopic rotator cuff repair (aRCR), total shoulder arthroplasty (TSA) or trapeziectomy for thumb osteoarthritis (TMC OA) will be correlated with health-related costs. Furthermore, the incremental cost-utility-ratio (gain in Quality Adjusted Life Years) will be calculated.
Methods: This monocenter prospective study includes patients indicated for aRCR, TSA or TMC OA. Clinical examination and patient reported outcome data include: the EuroQol (five dimensions) 5-level version questionnaire score; Oxford Shoulder Score (OSS); Shoulder Pain and Disability Index; Constant Score (CS); Subjective Shoulder Value (SSV); brief Michigan Hand Outcomes questionnaire score; and the Hand Kapandji Index. These assessments are collected before surgery (baseline) as well as at 2-week, 3-, 6-, 12- and 24-month postoperative follow-ups. In addition, direct medical costs (provided by

insurance companies) and indirect costs (productivity losses) are determined. The entire cycle of care (inpatient and outpatient treatment) considers a period of 1 year before and up to 2 years after surgery. Changes in QOL (utilities) for the aRCR cohort were analyzed using a paired t-test.
Results: Currently, 164 patients (100 men) with a mean age of 57 years are included in the aRCR cohort, of which 138 underwent surgery. The first 82 patients were assessed up to the 6-month follow-up. From study enrollment to surgery, utilities decreased from 0.75 to 0.71 points ($p < 0.05$). A comparison of outcomes between baseline and 6 months post-surgery shows that utilities increased from 0.69 to 0.89 points, OSS increased from 26.6 to 40.7 points, SSV from 50.7% to 82.1%, and CS from 41.7 to 68.8 points ($p < 0.001$).
Conclusions: There is a statistically significant and clinically relevant improvement in QOL and shoulder function for aRCR patients between enrollment and the 6-month follow-up. These results will be related with health-related costs based on the incremental cost-utility-ratio. This information will provide important insight for determining and evaluating the costs and utilities of common orthopedic procedures in Swiss routine care.

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