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

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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 femoracetabular 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 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 implemented using VisiBone’s 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 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.

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

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Introduction: Legg-Calvé-Perthes disease (LCPD) results in a complex deformity of the hip with a morphological 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 periaricular 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 non-hips.

Methods: We retrospectively quantified the anatomy of 18 periaricular muscle muscles using MR arthrography. We evaluated muscle diameter, CSA, and fatty infiltration according to Goutallier. A series of 68 hips (67 patients) with a diagnosis of LCPD were included to a study group 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: Periaricular 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.

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

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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 and arterial (red) care, 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 vessels 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.

A bibliometric analysis of citation classics in orthopaedic hip research

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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 orthopedics, 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 & arthropathy, 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 6 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 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.

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

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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), transtrochanteral (n = 19) or transtrochanteric (n = 13). A monoblock (Wagner SL, n = 59) or modular revision (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 revision. In the 3rd patient we were not able to control infection and excartilization was performed. Furthermore, 1 stem was revised for aseptic looseness (1), 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). A subsidence >6 mm was seen in 3 patients. Proximal cortical remodelling after transfemoral approach was excellent or good in 71% (32 excellent, 9 good) without any 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). Radioluencies 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.

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

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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 iliopsoas 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. Radiographic evaluation was performed. The patients were, divided into 2 groups: Group I: without fracture dislocation of the lesser trochanter. Group II: with fracture dislocation of the lesser trochanter

Results: 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. Radiographic evaluation was performed. The patients were, divided into 2 groups: Group I: without fracture dislocation of the lesser trochanter. Group II: with fracture dislocation of the lesser trochanter

Conclusion: Group I had a greater increase of fatty infiltration in the iliopsoas muscle than Group II. This is in contrast with a previous study where it was shown that a dislocation of the lesser trochanter does not lead to increased fatty infiltration in the iliopsoas muscle. This study showed that a dislocation of the lesser trochanter does not lead to increased fatty infiltration in the iliopsoas muscle. This study showed that a dislocation of the lesser trochanter does not lead to increased fatty infiltration in the iliopsoas muscle. This study showed that a dislocation of the lesser trochanter does not lead to increased fatty infiltration in the iliopsoas muscle. This study showed that a dislocation of the lesser trochanter does not lead to increased fatty infiltration in the iliopsoas muscle. This study showed that a dislocation of the lesser trochanter does not lead to increased fatty infiltration in the iliopsoas muscle.
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, eating, using the bathroom: 2-4 ADL: 2A, 0-1; 2B, 4; 3A, 2-3; 3B, 0-1: C 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% respectively 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 proving the benefits of the individualized and focused measures of a specialized geriatric fracture center in terms of the functional outcomes after geriatric hip fractures.

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**“Swiss Fracture Liaison Service” – secondary fracture prevention becomes a standard of care!**

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**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 will 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 DGOGO, 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.

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**Histological characterization of hip cement restrictor induced osteolysis in the femur**

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**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®, 1000PEG70PBT30 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 aseptic 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 accompanied by 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 prosthesis stem appeared to prevent the ascension of osteolysis.

**Conclusion:** We found that the BCR (SynPlug, 1000PEG70PBT30 PolyActive) reabsorbs very slowly and remnents 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.

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

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**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-MRIs to predict failures after surgical treatment of FAI based on specific preoperative arthro-MRIs of the hip at a minimum follow-up of 10 years.

**Results:** Failed hips at a 10-year follow up where more likely to show chondral damage, presence of osseous/perilabral cysts, labral ganglia, perifoveal/posteroinferior/central/lateral beginning osteophytes, subtle joint decentration. Patients were then evaluated clinically and radiographically at a minimum follow-up of 10 years. 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.

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Methods: Preoperative arthro-MRIs were performed in all patients. 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.

Conclusion: We found a significantly (p = 0.009) decreased survivorship of the hip for the protraction group (59% [95% confidence interval, 42–76%) compared to control group (83% [95% CI, 75–91%]) with the endpoints stated above.

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

Method: 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 EQSD 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: Thirty 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% of patients were 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 rates or outcome scores in 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.

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

Introduction: Ligamentum teres (LT) has a role in hip biomechanics, stability, nociception and proprioception. Lesions of LT may be associated with hip instability. The diagnosis of LT injury may be challenging. Therefore, the aim of this study was to validate a new clinical test to assess LT injury in patients with hip instability.

Results: The new clinical test for LT injury, the anterior luxation test, was performed on 107 patients with hip instability. The test had a sensitivity of 91.3% (95% CI, 84.3–96.4%) and a specificity of 87.1% (95% CI, 82.1–90.9%). The positive predictive value (PPV) was 86.4% (95% CI, 79.8–91.2%) and the negative predictive value (NPV) was 90.8% (95% CI, 85.7–94.3%). The test was highly reproducible, with a test-retest reliability of 0.91 (95% CI, 0.86–0.94).

Conclusion: The anterior luxation test is a reliable and valid clinical test for assessing LT injury in patients with hip instability. It should be included in the diagnostic workup of patients with hip instability.
Return to sport after hip surgery for femoroacetabular impingement: a systematic review

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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 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 practice with different 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.

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

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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 loosening occurred. This corresponds to a cumulated survival rate of 94.7% at 17 and 91.8% at 18 years. The Harris 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 remodeling 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.

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

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Introduction: The optimal treatment of the ruptured anterior cruciate ligament (acl) remains still controversial. The legibility for operative reconstruction is the intention to delay osteoarthritis in the long term outcome. In order to find the most suitable treatment most of the studies use 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 referred 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 (4–7) 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 reconstruction option to comprehend on 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.

Biological induction in the healing of the anterior cruciate ligament

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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 allogeneic and xenogeneic technique of ACL reconstruction using different cell types and cell engineered tissues have raised the interest to bio-enhanced ACL repair implement regenerative approaches, such as platelet rich fibrin (PRF) and platelet rich plasma (PRP), in mechno-biologically modified ACL, as these models are able to fully restore the internal continuity function 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 mechno-biologically model of ACL in organ culture.

Methods: Fibroblasts were isolated in a 3D osteochondral 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 2 weeks. Regarding relative gene expression in donor-matched ACL and PCL 85% of the analysed genes didn’t show significant (P >0.05) difference between ALC and PCL.

Conclusions: This study demonstrates that PRP 20% expresses stronger therapeutic effects than PRF or in-vitro expanded fibroblasts. Moreover, gene expression profile comparison of donor-matched ACL and PCL suggests that PCL can be used as internal control.

Good video gamers are better arthroscopists

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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 hand-eye coordination. 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 arthroscopy simulator 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"

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

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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: 52 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, rheumatologic lateral femoral notch, persistent gap between the ruptured ends of the ligament. 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-G 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). Preoperatively 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.

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

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Purpose: determine the long term outcome of anterior cruciate ligament reconstruction (ACL) 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 four 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 ± 6.6y. 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 6.6 ± 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%) meniscectomy, 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 meniscectomy (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 also had a tendency to be lower. 92.9% of knees that sustained a meniscectomy had some degree of OA changes in the related compartment (p < 0.001). In patients with intact meniscus at the end of the follow up (n = 50), 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 meniscectomy 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 meniscectomy but not femoral tunnel malposition is associated with increased risk of OA and pain after ACLR. A malposition of the femoral tunnel is rather associated with higher KOOS sport component. At 23 y, less than 1/6 of ACLR had failed but almost 1/2 of the patients had a remaining fear for injury recurrence.

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

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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 separate group. IRB consent was not needed for this study.

Results: 208 patients with an 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 allograft, 15 (7.5%) with a bone-patellar tendon-bone allograft hybrid, and 5 (2.5%) with a second collateral stabilization with ITB. 56% had at least one concurrent injury. 66 (32%) had a meniscal 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.

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

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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 = 0.0005). 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.

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

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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 ACL reconstruction.

Methods: 39 patients (me an age 34 ± 10 years) underwent arthroscopic CMI after subtotal medial (n = 32) or lateral meniscus (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. Inversion of the meniscus was noted. Implant failure was defined as infection or mechanical failure. The minimum follow-up time was 36 months.

Results: The mean Tegner score preinjury was 7 (range 3–10), it decreased preoperatively to median 3.5 (range 1–9) and nearly reached the preinjury level at last follow-up (median 7.5, range 1–9). 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 145° ± 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 ± 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 signs of bone marrow edema. 10 patients (53%) showed signs of BM. 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 short remodeling period, degeneration and extrusion in a significant number of patients.

FREE COMMUNICATIONS
MPFL-reconstruction using gracilis tendon autograft in 114 knees – a mean follow-up study of 5.4 years
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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 postoperative result. 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 primary reoperation and recurrent subluxations each. Re-operation was performed in 24 patients (21.2%), mainly for hardware removal (N = 13) and for 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.

Dynamic intraligamentary stabilization: a treatment option for acute ACL ruptures?
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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 stabilization (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 hypertrophic 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 course of years. Further investigations should be performed to elucidate the best candidates for the procedure, and optimization of the device is necessary.

Reinterventions nach banderverhaltender 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

Visual-palpatory versus fluoroscopic intraoperative determination of the femoral entry point in MPFL reconstruction: a cadaver study
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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 fixed cadaver legs. The blinded procedures were repeated three times, subjective difficulty of the procedure 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 of the correct entry point in the study was 3.5 mm (range, 0 to 18 mm). 29% of all patellar 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. No significant differences were 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),...
Is a valuable option to perform anterior cruciate ligament reconstruction in day case surgery? Prospective comparative non randomized monocentric study of 60 cases

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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 assessed 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 (57% 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 patients.

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

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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 peripheral suture can be considered.

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

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

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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 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 drill 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 mm² in the CG and 2.4 mm and 4.7 mm² in the TG. The mean areas of the bone tunnel were 5.7 mm², 5.2 mm² and 4.1 mm² (entry/middle/deep) in the CG and 4.2 mm², 3.7 mm² and 2.6 mm² 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.

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

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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 presentations of efficacy after 12 months are also presented.

Methods: Ten patients with symptomatic, post-traumatic full-thickness cartilage lesions (2–8 cm²) 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 (Chondrogrid®, 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 (dGMERIC, 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 dGMERIC revealed a relative J1R1 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 J1R1 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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In-screw cement augmentation for iliosacral screw fixation in posterior ring pathologies with insufficient bone stock

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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 in the 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).

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 loosening of bone refill, 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.

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

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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 a paramount. In case of lumbar 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.

Results: L5I, L5 tilt, L5 slope and L5% of PI mean values were respectively 22.43 ± 4.65, 17.73 ± 40.72. Pearson correlation between L5I and pelvic incidence was 0.63. 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 (<0.05). ODI and VAS showed that patients represent an asymptomatic population.

Conclusion: This 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 SI incidence. The normative values provided in this study will help to control respectively the lordosis restoration for patients with lombo-sacral variations.

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?

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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 = 0.89, p < 0.001). Postoperative CT - guided indirect injection (−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.

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

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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 outcome have not 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 ± (±2.9) 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 7 out of 109 (0.7%). P7 rest tilted a new L5 motor deficits postoperatively. 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 91.1%.

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 awaited 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.
Survival rate after repeat surgery of chordomas of the cervical spine—incorporating the cranio-cervical junction
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Introduction: Chordomas rarely metastasize but do 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 133) months.)

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 photon beam radiation therapy, a survival rate can be achieved that is similar to that reported in the literature following first time chordoma removal.

Human intervertebral disc stiffness correlates better with the Otsu threshold of its axial T2 map than with clinical classifications
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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 nucleus. (Nucleus pulposus (NP), 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 is homogenity 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 [Gedet, 2007] and stiffnesses were computed from the load-deformation curves.

Results: The grading systems correlated significantly with each other (Th/Ba: R2 = 0.84, Th/Wa: R2 = 0.73), with compression and torsion stiffnesses. TOTSUAF and TOTSUPostAF correlated significantly with Thompson (R2 = 0.49 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.

A combined cellular and biomaterial approach for the restoration of disc height and prevention of degeneration in discs with annular defects
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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. Anlotulot was performed in caudal bovine discs and PTMC scaffolds were press-fitted into the defects. Scaffolds were immobilized 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.

Results: PTMC scaffolds remained stable within the AF defect for up to 14 days, and no proliferation of nucleus pulposus (NP) was observed. The disc height was maintained after mechanical loading and recovery, while in a control group without 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.
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 to a higher extent than the AF cells 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.

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; 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 = –0.39). Overall patient satisfaction VAS lumbar was reduced from 72 (S.D.35.8) to 8 (S.D.5.8) after six months. Asymptomatic screw loosening was found in two patients treated for complications and assessing the onset of spinal disease and implant artifacts in CT and especially MR imaging. This may facilitate 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.

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.

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

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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 disease. 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 study was prospective to properly 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. The SVA provides a reliable and consistent method to quantify leg asymmetry. No significant difference 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 might be one reason for this observation. The subtalar vertical angle (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.

Results: Up to 60% of patients with osteoarthritis of the ankle joint develop a tilt of the talus with further progression. The tilt, the talocalcaneal angle (TCA) was mostly seen for arthritic varus ankles, while a varus-varus-varus configuration was seen in the nonarthritic ankles. No tilt was seen in the nonarthritic varus ankles and the SVA was between 44° and 50°.

Conclusion: The SVA is a very responsive disease-specific instrument for assessing the many 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 as 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 = 41) treatment, 146 patients (125 F, 21 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).

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

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Introduction: Joint kinematics 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 coordination 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 valuable 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 were measured and their phase angles (\( \phi \)) calculated. Continuous relative phase (CRP) were also obtained; \( \phi \)-ff-hf, \( \phi \)-hf-sh and \( \phi \)-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 peaks indicate vice versa. \( \delta \) Controls; ff-hf and hf-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. \( \delta \) 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. \( \delta \) AA: The gait showed the modified mechanics of rotation in hf-hf and hf-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: This study was 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.

Tibiotalocalcaneal vs tibiotalar fusion: a biomechanical comparison

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Introduction: Tibiotalar 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 AA patients. Therefore, both the distal articulation (AA) and AA, therefore, not only the tibiotalar joint 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 questionnaire (EQ 5D, AOFAS-hindfoot and FAAM). Each subject performed 2 walking trials of 50 m, per foot. Gait parameters assessed include: Planar pressure parameters (PPP), kinematics and spatiotemporal parameters. Statistical analysis included the 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 the 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 being 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.
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 untreated situation) for an applied tension of 350N.

Conclusion: Thickness of the plantar fascia restricts dorsiflexion at the first metatarsal joint and results in HLF. Based on these data the authors continue to extend their research in identifying the potential initiating causes of hallux rigidity.

The modified Kramer osteotomy for hallux valgus correction – a long-term outcome study
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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 an average 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 followed up 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 plantar configuration and good clinical long-term outcome may be achieved even in patients with severe deformity.

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-rance of CN. In accordance with the Etchelothenn 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 bilaterally 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 appearance of ulceration between bilaterally compared to unilaterally affected patients with an off-loading regimen (p = 0.004). Soft-tissue infection rate was higher for protected weightbearing patients (7%) than for protected weightbearing patients (3%). 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.

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 the concomitant osteomyelitis, the risk of infection and 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 region and group 2: osteomyelitis outside 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 40% of the 30 cases in group 2 (p = 0.091). The amputation level was higher in group 1 (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.

The Taylor Spatial Frame used as a compression device for hindfoot re-arthrodesis
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Introduction: One of the most challenging situations in foot reconstructive surgery is a chronic prosthesis 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 a 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 analgesic approach which included simultaneous surgical debridement with or without bonygrafting and external stabilization.
with the TSF. The charts were reviewed for aramnosis, 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 amputation 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

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**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 ankle arthrodesis with the TSF. The charts were reviewed for anamnesis, the surgical procedures in detail, postoperative course and complications. 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 surgical approach gave a 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 surgeon 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 treatment 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 56**

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

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**Objective:** Open reduction and internal fixation by an L-shaped Seattle approach has developed to a gold standard in the treatment of displaced calcaneal fractures. But wound complications are common and often causing a longer time of hospitalization. Thus, there is 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 subtalalar approach.

**Methods:** The incision is a small 5–8 cm incision over the subtalular 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, offset-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 subtalular joint approach gave a 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 surgeon 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 treatment 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

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**Background:** Open rather than closed reduction and temporary arthrodesis as well as primary definitive arthrodesis are well accepted for ligamentous and osseous Lisfranc injuries. Our prospective series with 29 patients will show 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 using 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 radiograph was mild/moderate/severe in 5/30 ligamentous injuries and in 7/21 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.
Treatment of severe foot deformity with the
Taylor Spatial Frame
Dr. Hannes Manner, Schultess Klinik, Zürich/CH;
Dr. Rafael Velasco, Schultess 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.

Results: Follow up ranges from 6 to 10 years.

Conclusions: 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.

Elbow dislocation in children. A retrospective study
Maria Stoichita/DE; Martina Rothenbühler/DE; Dr Aline Bregou
Bourgeois, CHUV, Forei/CH; Dr. Stephane Terrier/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.

Fixing by two or three parallel pins bridged
in supracondylar fractures in children
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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 humeri 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 instability fracture type 4 or in flexion,
the 3 pins solution remains the most stable.

Keywords: Biomechanical analysis supracondylar fracture, humerus,
plug, pin bridging.

Metamorphosis of normal human lumbar vertebrae
to quadreped-like shape by VEPTTR induced growth
modulation
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Dr. Daniel Studer, Universitätskinderspital beider Basel, Basel/CH;
Dr. Philippe Bächler, University of Bern, Medical Faculty, Bern/CH

Study Design: Retrospective radiographic Objective: To assess the
growth modulating impact of yearlong distraction-based VEPTTR-
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 VEPTTR 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: VEPTTR 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 VEPTTR removal at the end of growth is uncertain.
**FREE COMMUNICATIONS**

**FM 62**

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

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**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/N) between the lengths of the instrumented (I) and non instrumented (NI) parts of the spine.

**Results:** The PKG length of the spine would grow less than the normal vertebrae. We therefore hypothesized 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, 2 idiopathic, 1 secondary) treated at our institution with an observation period of 4 years. The relative lengths after the index procedure R1 and after years R2 were statistically evaluated by paired-sample-t-tests (SPSS, Vers. 7.1, significance level p < 0.05) by an independent observer.

**Conclusions:** A new software and methodology provides reliable assessment of the growth stimulating effects of spinal implants in children with early onset scoliosis. VEPtr implantation led to repeat half-yearly 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**

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

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**Introduction:** Phonography (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 muscle contraction during ACS in a rat model. 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 6h 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 harvested.

**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 phonography 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 histopathological 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 (PDLT): a modified animal model to study dynamic tendon-bone healing**

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**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 this 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 actuation. 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 PEEEK 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 cavity 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 dorsified 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:** PDLT 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**

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**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 various chondrocyte proteins 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
intranuclear 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 tissues obtained from donors 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), caspase-3 (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 18.5; 95% CI 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 collagen 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), TGFB-2 (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 intact knee joint. This result is surprising and adds to the literature that joint instability caused by muscle paralysis may promote an inflammatory intraarticular milieu, which may contribute to the development of early stages of OA.

ROBUST-regeneration of osteoporotic bone using stem cell transplantation

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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 implantation 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 analysis 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 tissued as cell source for bone grafting is safe and feasible. The heterogeneous SVF could support vascularisation additional to bone formation, circumventing the dysfunctionality of bone marrow derived stem cells in elderly patients. This proof of principle underlines the prospects of the approach as alternative to standard grafting procedures.


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

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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 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 explanted for 72 hours to IL-1β/TNF-α (inflammation culture) and then cultured up to 14 days in medium containing 1% FBS supplemented NCCM (2% NCCM) or 2% FBS supplemented ADMEM (ctrl) (recovery culture). Pellets generated with OA chondrocytes without inflammatory pretreatment were cultured in NCCM- or ctrl-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-1β/TNF-α-treated chondrocytes from healthy patients >55 years and by end stage OA articular cartilage. 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.

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

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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 plates and femoral heads were obtained from patients undergoing total knee and hip arthroplasty. Subchondral bone tissues from nonsclerotic and sclerotic regions as well as decalcified and nucleated bone marrow cells were isolated. Osteogenic (CFO-U) and total number of colonies (CFU-f) were counted after alkaline phosphate (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 170 ± 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.

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**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. Ayaj Matta, Toronto Western Research Institute, Toronto, Ontario/CA; Sarah Kim, Toronto Western Research Institute, Toronto, Ontario/CA; Prof. Dr. Michael G Fehlings, Toronto Western Research Institute, Toronto, Ontario/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 NP cells) 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% O2) and treated with Etosip (all supplemented with 2% fetal bovine serum). Chondrocytes and osteoblasts were isolated and processed, 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 Cytochrome 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 TGF-1 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 Etosip, 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 TGF-f1. Differences in cytokine expression of responders vs. non-responders suggest a different 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 increases the expression of EGM 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.

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**Corrective osteotomies of phalangeal and metacarpal malunions using patient-specific guides:**

Dr. Stephanie Hisinger, Uniklinik Balgirst, Zürich/CH; Dr. Junichi Miyake/JP; Dr. Philipp Fromstahl/CH; Prof. Dr. Ladislav Nagy/CH; PD Dr. Andreas Schweizer; Uniklinik Balgirst, Zürich/CH

**Introduction:** Corrective osteotomy of metacarpal or 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 Balgirst 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 13.2° (range 9.5–24°) and 9.3 mm (range 1.6–3.6 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.

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**Collagenase injection in Dupuytren’s disease:**

Caroline Krefter, Schultess Klinik, Zürich/CH; Dr. Miriam Marks, Schultess Klinik, Zürich/CH; Martina Wehrli, Schultess Klinik/CH; Stefanie Hensler, Schultess Klinik, Zürich/CH; Dr. Daniel Herren, Schultess Klinik, Zürich/CH; Dr. Stephan Schindele, Schultess Klinik, Zürich/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 (bMHQ) 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 <0.001). In the bMHQ patients increased from 73 (+15) to 81 (+13) points (p <0.001). With the exception of a flexor tendon rupture directly after 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 unexpectedly and diabetics were further examined 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.

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 anatomical 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.

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 remove further stages of debridement. When increasing stages of debridement, 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.

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 unexpectedly and diabetics were further examined 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.

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.

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

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

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Introduction: When assessing functional outcomes in orthopedics, accurate measurement 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 comparison 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 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 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 –7.6° (±9.3). 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 (p = 0.6 ± 8.5) 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 except for P. Nonetheless, we found it to be very useful to measure the elbow’s full arc of motion when measured free in the air.
Haptic assessment of bone quality: is there a consensus and can it be trained?

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Introduction: New stem free designs of shoulder prostheses are promising developments but, rely on good bone quality. Orthopaedic surgeons ultimately aim 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 unblinding how the pressure of 1.7 kg/cm² "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/cm². The pressure at initial measurement did not correlate to level of experience, age, or 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 than less experienced (residents). This difference was even more pronounced when comparing 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 apply haptic assessment better than the less experienced.

Allograft reconstruction for the proximal humerus – does it work?

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Introduction: Large bone defects of the proximal humerus after tumour resections or complicated revision surgeries are challenging. 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 allograft (OA) or an allograft-prosthetic composite (APC) can be used. As seen in OA. But APC together with reverse shoulder prosthesis should be carefully considered as they show the poorest long-term survival.

Results: Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Prof. Rodolfo Capanna, Azienda Ospedaliero Universitaria Careggi, Firenze, Italy/IT; Dr. Sven Tülnner/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 considered, but also because evidence based recommendation are sparse and fragmented. We condensed the current state of evidence into one algorithm that should provide clear strategy for further treatment in 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 cause 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 fulfill 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 3 patients (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. osteosynthesis 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.

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

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Background: Anatomical 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 fractures of the proximal humerus in 51 patients of a mean age of 78 (58–89) years were 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 survivor survival of 50.9% after 10 years.

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.
treated with RTSA and reviewed clinically (constant score and subjective shoulder value) and radiographically 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 82.1 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.

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

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 December 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.

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

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: 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.

Results: There was one case of a superficial infection. After a mean follow-up of 12.3 months by 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 points (acute) and 9.8 points (chronic). The average of the ACJI was 90.7% in the acute and 85.2% 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.
The influence of radiographic viewing perspective and demographics on the Critical Shoulder Angle

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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. View-dependent 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 93%. 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 size or a double contour initiated at the upper glenoid less than 50% of glenoid height. Correlations between glenoid size and CSA were small (R ≤ 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.

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Is the acromioclavicular osteoarthritis in the MRI clinically relevant?

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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.

Discussion: Our data shows that inferior capsular shifts will produce predictable improvements in both 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.

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

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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 postraumatic 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 malposition (3) or non-union (10) at 12 (0–47) months. There were more revisions after...
The principles of humeral head reconstruction in shoulder arthroplasty

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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 digitized. Orientation (inclination, retroversion) and geometry (head height, length, width, length-width-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 ≤0.012). 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.

Conclusion:

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

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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 antibiotic 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 orthopedic 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 preoperative antimicrobial prophylaxis yielded a 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 preoperative 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 pre-antibiotics. Moreover, in 20 of these 54 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.

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

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Purpose: Accurately determining the causative pathogens in orthopedic 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 χ2-test.

Results: We reviewed 2632 episodes of community-acquired and nosocomial orthopedic infections. The study population had a median age of 57 years, included 828 females (31%), 311 bacteremic cases (12%), and 980 immune suppressed patients (37%). The types of infection included 312 prosthetic joint infections, 324 fracture-device infections, 522 osteoarticular infections, 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-

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

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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 performed between 3/1996 and 3/2013 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 TJA (mean age 69.6, 60% women) were included. TJA outcomes 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 1.3–3.5) 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. Further research with other antibiotics and surgical conditions is warranted.
Surgical Technique: Custom made modular megaspacer for the two-stage treatment of implant-associated infection of a total femur prosthesis

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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 endoprostheses 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 Harlingston stainless steel rod. Under traction the modularity connecting element allowed optimum length 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 week 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 finalisation of a total prostheses is simplified.

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

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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 rotationplasty. After extensive discussion with the patient, we decided to perform a rotationplasty. 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

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

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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 of infection within one 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), 5,390 (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 infections were for group 1, 2 and 3, respectively as follows: 7.0, 13.0 and 15.2 per 1,000 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 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 incidence was estimated already in the first year after surgery and did not change thereafter.

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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-dependent and class-specific. Aminoglycosides, quinolones, glycopeptides, some macrolides, tetracycline aztreonam, trimethoprim/sulfamethoxazole 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 showed enough stability for potential local application.

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FREE COMMUNICATIONS

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

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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 rotationplasty. After extensive discussion with the patient, we decided to perform a rotationplasty. 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 crutches 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 microscopically negative margins. A surgical treatment without any RT showed after all an acceptable local control. In selected cases it seems to be an option to perform an initial intralesional resection (Group I) and to convert to a marginal resection (Group II) if the gross resection is not sufficient. 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, chemotheraphy, 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, 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.
Malignant bone disease of the hip treated with total hip arthroplasty
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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 two-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 protocolled surveys assessing patients before and after surgery are needed to further examine these findings. The issue of costs must also be addressed.

Approach to tumors of the acetabulum and proximal femur by surgical hip dislocation
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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 O 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 resection, reconstruction with iliac bone graft and protective LCP. F/u 3 years Patient 2: 24y old female patient; Osteochondroma anterio-cranial to lesser trochanter. Tangential resection, without recurrence at f/u 4 yrs Patient 3: 5y 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. Curettet and thermoagulated 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.

Megaprostheses implantation after wide resection of the proximal tibia in osteosarcoma patient: 29 years of follow-up
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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 prosthesis and, in selected cases, a megaprosthesis combined with an allograft or autograft. 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 multagent treatment approach has improved survival more patient become long-term survivors, 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 remarkable. 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, a new tumor prosthesis was not a viable option. Therefore the surgery had to be done as an extraarticular resection of the proximal humerus.

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 issue regarding the remaining life- expectancy.

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

Methods: Preoperative work-up showed an MDM2 negative, partly pleomorphic-spindle cell sarcoma of the right scapula and the proximal humerus as previously described by Tikhoff and Linberg was performed. A 6 mm Mersilene® band connecting the...
Chronic tendon tears and peripheral nerve injuries can contribute to muscle degeneration after tendon tear. It was therefore hypothesized that the absence of PARP1 would lead to less early inflammation, muscle atrophy and fatty infiltration subsequent to combined tenotomy and neurectomy 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 PCR (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 regressed 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.

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

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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...
Supraspinatus tendon load during abduction is dependent on the size of the critical shoulder angle.

A 3-dimensional finite element model

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 area 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 RCT CSA versus 55% for the normal CSA. To achieve stability (defined as shear forces being 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.

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

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 state of seven degrees of freedom robotic testing system. Torsoes 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 transosseous equivalent (TOE) technique. The GH kinematics were measured using retroreflective 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.
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

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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-model of the scapula was acquired using a preoperative CT scan. 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 planned 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.

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

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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 motion 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 the glenohumeral osteoarthritis.

Conclusion: This numerical study supports the clinical hypothesis that small CSA promotes the development of osteoarthritis.


Glenoid Loosening and Migration in Reverse Shoulder Arthroplasty

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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 68 patients. Among the excluded cases, 45 underwent a revision (67%) and 22 (33%) have been treated conservatively. Among the former group, 2 (4%) had removal of the implant, 25 (36%) a prosthetic revision and 18 (26%) a conversion in hemi-arthroplasty. Mean glenoid loosening and migration...
Underestimation of complications, the reason for multiple revisions after shoulder arthroplasty

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Background: Repetition of the same complication or apparition of a new one after revision shoulder arthroplasty may require revising a shoulder implant more than 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 pseudoparalyses. 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 mediatisation.

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 subcapsularis rupture and in RSA, underestimation of humeral shortening and excessive mediatisation; (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.

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

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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 former 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 modified glenoid implant and 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 lucencies defined as modified Molé scores >8) 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 and ≤5) 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 alloyfix with palacos cement is associated and highly significant with decrease of radiographic lucencies around the glenoid pegs in the tested setting.

Predicting factors of recovering active forward flexion after reverse shoulder arthroplasty

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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, pre- and intraoperative range of motion. The aim of this study was to determine if other predicting factors after RSA could be identified.

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 bicondylar knee with static posterior instability. We excluded patients with (1) incomplete documentation, (2) follow-up of less than 2 years, (3) any diagnosis (fracture sequela, 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.

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

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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.e. 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.

Is Arthroscopic remplissage a tenodesis or capsulolysis? An anatomic study

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Purpose: Arthroscopic remplissage of a Hill-Sachs lesion is classically described as a capsulolysis 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 capsulolysis 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 musculotendinous 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 capsulolysis of infraspinatus and teres minor rather than a capsulolysis of the infraspinatus as previously believed. Clinical evaluation of capsulolysis alone should be evaluated in the future.
Projections. All images were calibrated with the KingMark setting followed a standardised protocol to achieve reproducible FO on AP radiographs of the pelvis and the hip. In 55 patients, both pelvis and the hip radiographs have been recommended for an accurate assessment in total hip arthroplasty improves abductor strength and range of motion.

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 < 0.001). We observed a linear relationship between the FO measured on hip and ap pelvis ap radiographs (r² = 0.97). Externally rotated hips showed a significantly higher FO on hip AP radiographs (χ² 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 is externally and internally 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 patient’s 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.

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

Introduction: The increasing use of minimally invasive surgery (MIS) and muscle sparing approaches as well as the need for bone stock preservation have led to the development of short stems TiAl showed an increased risk for aseptic loosening. No further stem migration was observed at 24 months of FU. Observed at 6 and 12 months of FU were 2.7 vs 3.7% and 1.5 vs 1.1% respectively. Stem migration (range 1.0 to 7.0) and 2.7 mm (range 1.0 to 15.0) respectively. Stem migration 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 arthroplasty in the elderly. Nevertheless, a longer follow up and larger prospective studies are necessary in order to further support this hypothesis.

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

Introduction: The femorocacetabular impingement (FAI) concept has been considered as a "new" pathomechanism after its first explicit description in 2003. Looking back into the history, sparse anecdotal...
14 year follow-up of the cemented Weber stem: survivorship of a composite beam (shape closed) stem

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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 cemented implants 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 the remaining 85 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 periosteal 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 follow-up at 14 years, the mean Harris Hip Score was 89 points.

Conclusion: Our data shows excellent long-term survivorship of the cemented Weber stem. Its composite beam design with a tapered geometry allows excellent long-term survivorship, independent 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%.
Association of patient satisfaction with the Oxford Hip Score and the Forgotten Joint Score after total hip arthroplasty (THA) will increase within Kantonsspital Baselland/CH; PD Dr. Thomas Ilchmann, Leonardo – Lilianna Bolliger, Kantonsspital Baselland/CH; PD Dr. Karl Stoffel, 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 socio-economic 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 (75%). Mean age was 67.2y (SD11.5) with 59.8% female. OHS were 40.1 ± 16 months and 40.9 ± 12 months after surgery. FJS were 56.3 ± 6 months and 61.2 ± 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 strongly 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.

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

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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 Böhmer osteolysis and radioluencies 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.

Lower extremity muscle weakness in patients with symptomatic hip osteoarthritis

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Introduction: Primary stability of the femoral stem is essential for the long-term success of cementless total hip arthroplasty. Excessive micromotion at the stem bone 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 orthopaedic 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. The 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 unloading. Micromotion in three dimensions was defined as the displacement of each corresponding bone marker 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.
Methods: Twenty patients (64.5 ± 5 ym, 173.5 ± 8 cm, 770 ± 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 voluntary maximum 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 (α = 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 2% 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. However, 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.

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

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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 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 of 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, and 12 months after TJR. 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.

PHM 131

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

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PD Dr. Michael Leunig, Schulthess Klinik, Zürich/CH

Introduction: Many studies report gender differences in patient-reported outcomes 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.

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

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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 53 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 Disability Score (MCPCDS), 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%.

Conclusion: 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.
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

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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 un cemented 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 months; and 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 debridment 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 134**

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

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**Introduction:** The responder rate describes the rate of patients responding to treatment having a reduction of symptoms and/or disability above the level of minimal clinically important difference. It was defined for 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 criterion depends on one or two of three subcriteria. 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 PROs with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) follow-ups pre-THR and one year postoperatively with unilateral THR. The EUROPHIP 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. The new method compared to the OMERACT-OARSI method using receiver operator characteristic (ROC) curve analysis for sensitivity, specificity and percentage of appropriately classified patients.

**Results:** With the new method 85.4% of the patients were classified as response-ers, applying the OARSI-OMERACT method 85.7%. The new method had 98.8% sensitivity, 94.2% specificity and 98.1% of appropriately classified patients.

**Conclusions:** A new method identifies 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; Liliana Bolliger, Kantonsospital Baselland; Dr. Regina Classen, CH; Dr. Martin Claus, Kantonsospital Baselland, Liestal/STH

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 was to compare: 1) The percentage of forgotten knees, and 2) the functional results of the BCA patients versus TKAs patients at a minimum follow-up of 2 years.

**Methods:** 1,327 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.
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 Joint Score (RUS-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 Score 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.

Does stemmed tibial component in total knee arthroplasty improve outcomes in patients with a Body Mass Index greater than 30 kg/m²?

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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/m².

Methods: We randomized 120 patients into 4 groups (stemmed tibial component versus non-stemmed in low groups: 30 <BMI <35 and BMI >35 kg/m²) 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 metaphyseal cementation. Every patient was evaluated pre-operatively using a Dexe 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/m² considering post-operative pain score >3 as the end-point, not having a stem was factor risk with OR = 4.2, 95% CI [3.45–6.86] 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/m² and in women with an osteoporotic bone with a BMI comprise between 30 and 35 kg/m². 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.

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

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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, internal 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 Femur) 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.

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

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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 TKA 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’s questionnaire score, Oxford knee score and EQ-SD (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.

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

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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 (CAS) can be shorter and lower, consequently, the costs of postoperative care. On the other hand the biologic reattachment of the patellar tendon and the better bone stock favor the use of an APC. The superiority of TKA with the tibia first technique in 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.

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 who have undergone a reconstruction of the proximal tendon and the better bone stock favor the use of an APC. 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 our 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 undergo a minor surgery and 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 with low bone destruction 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 slighter complication rate, especially a lower infection rate and less soft tissue failures. Surprisingly the functional outcome of the CMP was comparable to the APC.

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

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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

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

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Introduction: Unicompartmental knee arthroplasty (UKA) has proven its efficacy in treating knee osteoarthritis and has the advantages 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: At one year there were no significant differences between the two different techniques. The APC group was associated with a slighter complication rate, especially a lower infection rate and less soft tissue failures. Surprisingly the functional outcome of the CMP was comparable to the APC.
Analysis of postoperative alignment of three different techniques of total knee arthroplasty in severe varus / valgus deformity

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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 instrumentation, 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 malalignment (>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 analysed retrospectively. All patients received a primary knee arthroplasty in our institution with either a conventional (CN; n = 53), a computer navigated (CN; n = 47) or a computer navigation and patient specific instrumented (PS; 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 CN 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 CN 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.

Clinical results 10 years after AMIC in the knee

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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 18 males and 16 females. All patients completed a Lysholm Score for preoperative evaluation. We also included VAS for pain evaluation preoperatively, at 2 and at 10 years postoperatively. Statistical analysis for Lysholm and VAS included mean values and standard deviation.

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 2.26). 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 0.896).

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.

Unicompartmental arthroplasty for knee osteoarthritis

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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: Primium 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. Secondary 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 surgery. Registros were searched for survival 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 particular regarding concealment of allocation and assessor binding 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 outcomes of Revision 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, binding of outcome assessors and correct methodology are required to determine the optimal treatment of advanced unicompartmental OA of the knee.
Faster recovery without the use of a tourniquet in total knee arthroplasty

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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 were performed by the same surgeon and follow up was for 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 resulted in faster recovery in terms of better functional outcome 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 68.9 (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 surgical 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.

Knee arthrodesis using modular Wicha fusion nail

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1. Introduction: Indications for knee arthrodesis include severe instability, inadequate soft tissue coverage or extensor mechanism deficit. The most frequent indication is current 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 35%. 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 Wicha® fusion nail (WFN; Stryker Orthopedics, Mahwah, 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 most common 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 rearthrodthesis for non-union. The complications included one suspicion of infection treated by debridement by WFN, one peri-prosthetic fracture treated by ORIF and three cases of pseudarthrosis for which plates were used. All patients walked full weight bearing.

4. Discussion: In the literature, bony fusion after arthrodesis by modularly nail is acquired in 78.61% (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.

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

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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 ≥ 51 10) operated with TKA during this period. Five different cruciate-retaining TKA systems were used in consecutive 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) Balainsys, Mathys, Bettlach, Switzerland (n = 129), E) Duracoen, 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-RR)”. Pearson Coefficient correlations were 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.
Is trochlear dysplasia rather dupratrochlear? A comparison of Dejour’s classification on conventional radiographs and MRI

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Introduction: Trochlear dysplasia is one of the major risk factors for secondary patellar dislocation. As previously shown [3], walking with increased mediolateral trunk sway (+8 ± 4°; P < 0.001) was associated with lower pKAM (–18 ± 12%; P < 0.001), greater contralateral abdominal oblique (+74 ± 59%; P < 0.001), and lower ipsilateral gluteus medius EMG intensity (–18 ± 49%; P = 0.018).

Conclusions: Prosthesis design influences the need for secondary patellar dislocation surgery. It was shown that the rate ranges from 1 to 7%. The highest rate for secondary patellar dislocation was found in the PFC Sigma TKR.

Results: Twenty-six of 784 patients (3.3%) underwent secondary patellar dislocation 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%), and in group E one of 64 patients (1.6%) underwent secondary patellar dislocation 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 patellar dislocation surgery. It was shown that the rate ranges from 1 to 7%. The highest rate for secondary patellar dislocation was found in the PFC Sigma TKR.

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

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Introduction: The external knee adduction moment has been associated with the presence, severity and rate of progression of medial compartment knee osteoarthritis (OA). 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 (α = .025).

Results: Walking with increased mediolateral trunk sway (+8 ± 4°; P < 0.001) was associated with lower pKAM (–18 ± 12%; P < 0.001), greater contralateral abdominal oblique (+74 ± 59%; P < 0.001), and lower ipsilateral gluteus medius EMG intensity (–18 ± 49%; P = 0.018).

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:
Stainless steel wire versus fibrewire suture cerclage fixation to stabilize the humerus in total shoulder arthroplasty
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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 SSSC. 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, uncremented humeral prosthetic stems were inserted into an experimentally split humeral medullary canal, secured by the cerclage. After 100 N of preloading, the cerclage 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 SSSC (618 N) than FWC (13.537 N) (P < 0.001). Load to total failure was comparable among the 3 different FWC knots (2,642-2,804 N), which were significantly stronger than SSSC (1,775 N, P < 0.001). At 3 mm of distraction, SSSC (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 < 0.01). Subsidence testing showed no difference in force restraint or gap opening between the best FWC and SSSC.

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.

Postoperative rotator cuff healing: prospective comparison of MRI and US
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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 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% (0/3), type II in 45 (72.6%), type III in 4 (6.5%), 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.

Calcaneum and Achilles tendon allograft for bony and tendinous insufficiency of the posterosuperior rotator cuff in young patients
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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.

Electroneuromyography 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.

Early plate removal after locking plate osteosynthesis of proximal humeral fractures. A minimum of two-year follow-up
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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.
A rare case of corrective humeral osteotomy for a malpositioned glenohumeral arthrodesis with an intraoperative 3D CT guided navigation system (O-Arm®)

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Objective: The correct position of a shoulder arthrodesis is considered to be: 30° abduction, 30° anteverision 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 woman, 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 anteverision 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 operation and 1 year postoperatively 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 anteverision, 35 degrees of abduction, the internal rotation was unchanged. The osteotomy showed bony healing only after 7 months. 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.

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

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Introduction: Elbow arthroscopy is a challenging, yet extremely productive procedure in orthopaedic sports medicine. The severely constrained anatomy and adolescent growth factors make the elbow 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 neuropathy 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.

Selective supraspinatus atrophy due to suprascapular nerve compression

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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 paralarbal 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 paralarbal 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.

Carpal Tunnel Syndrome – is the Internet providing comprehensive patient information?  
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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 injuries 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, comprehensive information about CTS and its treatment has never been performed with a validated tool. There is an 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.

Carpal tunnel syndrome due to localized hypertrophic neuropathy  
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Introduction: Carpal tunnel syndrome (CTS) is a frequent pathology needing local and compression. Nerve compression is mainly due to the 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 hypersensibility 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 immunohistological 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.

Mechanical testing of 2 different variable angle locking plates for distal radius fractures  
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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 plate and 155.3 N for the Stryker plates with a 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 used to be preferred to free motion. 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.

Healthcare costs and loss of productivity in patients with trapeziometacarpal osteoarthritis  
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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 a 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 ≤0.001). 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.
Sesamoid fracture of the index: a rare cause of digital nerve compression

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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 the MCP-joint of the index finger followed by posttraumatic temporary digital nerve neuroparoxia.

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 plunifragmentary 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, 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 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.

PO POSTERS

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

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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.

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

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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€. With conservative treatment rapid recovery of the sensory deficit and uneventful fracture healing is observed.

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

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

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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 HCQ (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 1.39 (95%CI 0.91 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 HCQ, massive cervical tissue swelling in spine fusion. There is a slightly increased risk of new onset of tumors, however, without statistical significance.

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

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Background: The Lenke classification is well-established in determining 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 is 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.

Influence of gender on patient-oriented outcomes in spine surgery

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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 difference 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 confounders (preoperative COMI, ASA, complications, pathology), gender showed no significant association with the failure to achieve MCIC.

Conclusion: This result shows 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.
Union rate and complications in spine fusion with recombinant human bone morphogenic protein-7

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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 complications or revision rates with rhBMP-7. On the other hand we also found no evidence in support of improved union rates.

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

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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 pelvis 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). FIA, 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.
Avulsion fracture of the apophysis of the ischial tuberosity: The role of quadratus femoris
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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 ischiocutaneous muscles. Injury mechanism is usually a sudden and violent eccentric muscle contraction of the quadratus femoris when the patient 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 hamstring.

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 ischial pseustotumor leading to painful and oblique sitting position.

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
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Introduction: Cement extrusions on the femoral side after total hip replacements are a frequent observation. While mainly cortical circumferences with cortical defects filled with cement but no displacement of the avulsed fragment. Thus, the lesion involves mainly the quadratus femoris origin and less or only partially the origins of the ischial pseustotumor leading to painful and oblique sitting position.

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.

Direct anterior approach in supine position – comparison of two techniques: with and without legholder
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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 Inbruck 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; /Quada® 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 radiolucency 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 with an cemented stem 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/Quada (AT) are both safe and implants 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.
small labral tear and a foraminar 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 filliform 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 nerve compression. One possible therapeutic 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 tria 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.

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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 84% 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.
low sensitivity (25–38%) but a high specificity (94–97%). The diagnosis of meniscal injury showed low sensitivity (38–56%) 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.

How to evaluate bone tunnel widening after ACL reconstruction – a critical review
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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 assessing patients after ACL reconstruction and provide a detailed evidence-based literature overview, which is helpful to ACL surgeons and musculoskeletal radiologists.

Methods: 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. Percentages 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. 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.

Knee extensor muscle weakness after knee surgery: type of surgery and contributing factors
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Introduction: Anterior cruciate ligament (ACL) reconstruction, arthroscopic 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 muscle deficits 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.
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.

Surgical management of recurrent musculotendinous hamstring injury in professional athlete

**Introduction:** 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 this study was 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 10 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 a 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 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. When the 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.
Subchondral bone mineral density is heterogeneous on the femoral condyles and varies with osteoarthritis

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Discussion: In the anterior, central, and posterior regions, respectively. Different between the anterior (where it was greater than 1.0 for all anterior to the central and posterior regions. The ratio was significantly higher in knees with degenerated 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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Discussion: In the anterior, central, and posterior regions, respectively. Different between the anterior (where it was greater than 1.0 for all anterior to the central and posterior regions. The ratio was significantly higher in knees with degenerated 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.
The relative midfoot index as measure for impaired gait in ankle osteoarthritis

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**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.

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

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**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 Talias (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 5.550 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 cm³. 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 cm². 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 them regarding their reaction to axial compression.


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

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**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 differences between 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].
The use of 3D planning and patient specific instruments for femoral osteotomy of a malunited pediatric fracture – a case report
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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, 20° 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 ROM of the lower extremities.
Conclusion: Complex posttraumatic deformities of the lower limb in pediatric 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.

Polydactyly of the foot – treatment strategies: when, what and how to plan and perform surgery
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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 deformity of polydactyly demands in each case a 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 17 children, right foot in 15 patients and 3 patients had bilateral occurrence. 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 absent in 4 with hallux varus. Central ray involvement was present in 5 children, the remaining 37 duplications concerned the fifth ray. In our serie we found additional syndromes as 2 fibular hemimelia, 1 tibia antecurvata, 2 cleft feet, 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 (interference with shoes, development and function of the additional toe, ev. coxisms) and the x-ray/interpretation. This means that we preserve as much performed surgery as possible the lead of the end of first year. Age at surgery ranged from 12 month to 22 years, mean age 7yrs 6 months. The surgical techniques included pure ablation of the supernumerary toe, resection of the elongated metatarsal head or shaft, resection of the web space and correction of varus deformity of 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 adequate surgical techniques.
Conclusions: Considering the pathology of polydactyly, the morphologic classification and X-ray evaluation (taken between 8 and 12 months old) were described to lead satisfying functional and cosmetic results and makes secondary corrective surgery in most of the cases unnecessary.

Flexion-type supracondyulary humeral fracture with traumatic ulnar nerve transection – a treatment approach
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Introduction: Flexion-type supracondyulary humeral fractures represent only 2–10% of all supracondyulary fractures. The most commonly reported complication associated with this fracture type is an ulnar nerve injury. As the ulnar nerve passes behind the medial epicondyloide 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 a eight-year- old girl who was admitted to our hospital with a flexion-type supracondyulary fracture (type IV according to Lagrange and Rigault) and ulnar nerve palsy. Fracture treatment included closed reduction and lateral percutaneous 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 repositioned anteriorly using an intramuscular transposition technique.
Conclusion: Severely displaced flexion-type supracondyulary 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.

Meniscus transplantation in skeletally immature patients
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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 meniscal 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 technique 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 PediKDC, 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 subotal 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 12.8 ± 2.3 years. At a mean follow-up of 31 ± 20 months. The mean PediKDC 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 radiographs. One patient had to be revised for lysis of adhesions along the lateral miniarthroty and mobilization under anesthesia. The other two patients were able to
Comparison of two different entry points for elastic stable intramedullary nailing in pediatric radius fractures

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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) and were removed after 12 weeks (range 6–35). In the RS group, 3 (4%) temporary irritations to the superficial ramus of the radial nerve were observed. Two fractures, both due to an inadequate trauma and one fracture 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 the radial nerve and tendons to the entry point. The danger of permanent injury to the superficial ramus of the radial nerve may be overstimated 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.

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

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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 bilpraral 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 on MR images using MRI and 3D models compared to measurements on 3D models based on bilpraral radiographs (BPR).

Materials and Methods: Institutional review board waiver was obtained. FT and TT were measured in 30 children (mean age 10.1 years; range 6.2–15.6 years; 14 female) using axial MR imaging scouts by two independent readers. Measurements based on BPR 3D models by two separate independent readers served as reference standard. Interreader and intermethod agreement 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 0.98/0.94 on BPR 3D models. Intermethod agreement (ICC) for MR measurements was 0.93 (95% confidence interval [CI], 0.88–0.96) for FT and 0.87 (CI, 0.39–0.95) for TT. Mean measurement differences between the two BPR readers were 2.1° (–0.7°–7.0°) for FT and 3.4° (0.0°–12.0°) for TT. Mean interreader differences at MR were 3.2° (1.1°–8.0°) for FT and 3.5° (0.1°–9.5°) for TT. Bland-Altman plots showed no relevant differences between the two methods. 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 images are comparable to measurements on BPR 3D models.
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. Anteroposterior 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 fragment was reduced anatomically and held in place with a 3,5 mm cannulated screw with washer. The periostal flap was fixed using two staples. A Panaloc anchor (Deity 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.

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

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Purpose: Clinical experience suggests that a high proportion of orthopaedic infections occur in persons with diabetes. Surprisingly, there is little epidemiologic data (other than for 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 χ² 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 >5 times 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 (208/637 [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 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.

Staphylococcus aureus versus β-hemolytic streptococci in orthopaedic infections

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Purpose: Clinical experience suggests that S. aureus tends to form abscesses (e.g., carbuncles, septic bursitis), whereas streptococci more often cause phlegmones and diffuse spreading infections (e.g., erysipelas, necrotizing fasciitis). We were 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 information from 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-χ²-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 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 = 0.06).

Conclusions: Our results confirm the clinical impression that infection with S. 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.

Fever and its association with infection in polytrauma patients

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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-χ²-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-χ²-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 values <0.01). By multivariate analysis, fever had an independent significant association with infection (odds ratio 9.2, 95%CI 2.5–34.5); while surgery, open fractures, development of 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 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.

What duration of antibiotic therapy is needed after surgical treatment of patients hospitalized for soft-tissue diabetic foot infections (DFIs)?
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Purpose: The recommended duration of post-surgical antibiotic treatments 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 hospitalized in the Septic Orthopaedic Ward of 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, 9 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 prescribed antibiotics were amoxicillin/clavulanate, clindamycin, 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 recurrence. 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.

Is bioactive glass a valid bone substitute after debridement of infected or contaminated bone?
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Introduction: Treatment of infected or contaminated bone implies removal of devitalised bone and soft tissue and antibiotic implant and lack of bone coverage. Proposed treatment options are the use of antibiotic loaded polymethylmethacrylate (PMMA), autologous bone graft and bone substitutes. Recently bioactive glass (BAG) has been shown to have a large spectrum of antibacterial 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 properites it seems to be an excellent substitute. To our knowledge there is only one study reporting results of use of BAG in a septic environment. 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 antibiotic BAG implant. 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 cancellous 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 staphylococcus 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.

Risk factors for treatment failure of infected sacral pressure sores
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Infected sacral pressure sores 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 sores. 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 soft tissue infection. 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 (median 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 surgical infections, duration of total antibiotic prescription (HR 1.5 0.5–1.4) and/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-χ²-test; p = 0.90).

Conclusions: Our retrospective study of spinal cord injured patients with an infected sacral pressure sores 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.

Outcome of treatment of diabetic foot infections (DFIs) associated with colonisation or infection with MRSA or ESBL
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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)
but can be treated effectively when diagnosed, it is important that clinicians are aware of and careful with this rare condition. Imaging nor by synovial fluid white blood count, while biopsy can be the initial manifestation. Its characteristics do not differ much from that of ESBL carriage in our DFI patients. The rate of ESBL carriage among reported to be a rare feature of CML and is in few cases reported to be Acetabular manifestation of CML mimics septic arthritis from leukemic synovitis. 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 chronic 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 staphylococcus 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 a 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.
What proportion of clinical recurrences of diabetic foot infections (DFIs) are microbiologically due to new pathogens?

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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 120, including 130 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 using 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.

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

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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 infections hospitalised at Geneva University Hospitals from 2004 and 2014. We compared groups using the Pearson-χ²-test or the Wilcoxon-ranksum-test.

Results: Among 2632 episodes of orthopaedic infections, 78% 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 remaining were mixed implant infections, e.g., pins, wires, screws, spongoyodleses, 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). In contrast, implant-associated infections are significantly less frequently associated with: bacteriaemia (99/636 vs. 212/1996; p <0.01); immune suppression (17/636 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 bacteriaemia, immune suppression, or abscesses.

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

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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 (Hodgkin lesion). The patient and the parents 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 sarcoma board 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.

Methods: 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.

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

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Introduction: We present a case of a 61 year old female that was referred to our institution after resection of an inammary lipopigogenous tumor (CLB) of the right (CM) 5 cm) with local recurrences. 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 inflammatory 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 infraclavicular 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 history 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 62x50x53 mm heterogenous soft tissue mass that has increased in size since the first imaging. Although radiotherapy had been performed, a biopsy of the soft tissue mass was done and demonstrated a dedifferentiated liposarcoma. 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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**Internal Hemipelvectomy and reconstruction with a new hip transpositionplasty**

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**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 corticals. The tumor expansion required an Enneking Typ V/III/V resection including extra-articular resection of the hip joint. Because of high complication rates after allograft and endoprosthesis 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 proportioning incision was performed. After intra- and extrapelvic dissection, including subtotal detachment of the pelvic-femoral muscles, the tumor was exposed. First, an intertrochanter osteotomy was performed. Furthermore, osteotomy of the ramus superior pubis, ischium as an osteotomy latero 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 Modarresi/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 pelvic-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 fatigability. 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.

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

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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 22-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 next, following the brachial plexus distal to the axilla and resection of the tumor block within the planned margins. The bones were readapated by two plates, the neurovascular structures were reanastomosed microsurgically and the forearm was successfully reattached. The bones were readapted by two plates, the neurovascular structures were reanastomosed microsurgically and the forearm was successfully reattached. The pathological 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 anatomial situation only allowed a forequarter amputation, an R0-resection being the goal. The extensive amputation including scapula, costa I, II, pleura and clavicual osteotomy was performed five months after the primary surgery in cooperation with reconstructive surgeons. The pathoanatomical analysis showed a R0 resection.

Results: 10 months after the second surgery, the patient had adapted well to her new limb. She attended school and remained in school. She 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.

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

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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 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 lesion 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 osteous 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. Curetage 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.

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

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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 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 chemotherapy. Local treatment consisted in wide en bloc internal hemipelvectomy with a “flail hip”, sparing the femoral and sciatic nerves. After chemotherapy, the FD 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.

Surgical oncological strategic score

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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 juxtaparticular 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.

**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**

**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. Angloembolization 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 2.15 Gy = 62.35 Gy 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.
The effects of patient, injury and surgical variables on the PROMs following meniscal 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, Cochran and PubMed databases using the terms “meniscus”, “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.
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.

**Prospective clinical evaluation of a new anatomic cuff for forearm crutches**

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**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 assessing 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 endpoint.

**Results:** Pain (p = 0.005) and paraesthesia (p = 0.003) 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 = 0.021), role physical (p = 0.005), bodily pain (p = 0.005) and general health (p = 0.012) 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.

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

Knut Husmann/CH; Sander Botter/CH; Matthias Arti/CH; Else-Marie Pedersen/CH; Walter Born/CH; Prof. Dr. Bruno Fuchs, Universitätssklinik 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 resulted in primary tumor growth and lung metastases formation 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.

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

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

**Introduction:** Osteosarcoma (OS) patients have five-year-survival rates (5-yr) of approximately 60% receiving standard systemic intravenous (IV) application of cytotoxic drugs such as cisplatin (DDP). However, intraarterial (IA) chemotherapy can potentially improve treatment efficacy. Although clinical trials performed earlier failed to show a clear benefit, some studies using IA DDP demonstrated 5-yr survival rates (5-yr) of approximately 60%. 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), DDP (at 4 mg/kg) or vehicle (0.9% NaCl) was administered intravenously (IV) or intraarterially (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 DDP yielded the largest reduction of tumor volume measured by caliper (67 ± 20%; mean ± SEM % of initial tumor volume) compared to IV DDP (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 DDP-specific kidney damage was observed. In addition to tumor volume reduction, IA DDP significantly reduced the number of micrometastases (IA DDP: 68 ± 42 (mean ± SEM); IV DDP: 200 ± 15; IA NaCl: 680 ± 296; IV NaCl: 212 ± 41) as well as the number of macrometastases.

**Conclusion:** IA infusion of DDP shows superior efficacy 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.

**Sarcoma patient derived tumor cells obtained by the explant technique**

Roman Muff/CH; Sander Botter/CH; Knut Husmann/CH; Prof. Dr. Bruno Fuchs, Universitätssklinik 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 into 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
collagenase IA and single cell suspensions were directly profiled 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-derived cells were subjected to flow cytometry. High percentage (43–100%) of cells with abnormal karyotype were 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.

Targeting αvβ3 and αvβ5 integrins in osteosarcoma cells
Ana Gvozdenovic-Ch; Walter Born-Ch; Roman Muffi-Ch;
Prof. Dr. Bruno Fuchs, Universitätstinalklinik 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%. Surgery is the mainstay of local control; in cases where limbs are involved, amputation can result. The relapse risk is high and metastases, particularly in lung, are common. Effective therapeutic strategies are urgently needed.

Methods: Cell surface expression of αvβ3 and αvβ5 integrins was assessed by flow cytometry using Rh110-conjugated anti-human αv and β integrin antibodies. Cell viability was assessed by Trypan blue exclusion. Drug sensitivity was assessed using the MTT assay. Adhesion of OS cells was assessed using vitronectin-coated culture flasks.

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 2.7 µg/ml. Apoptosis 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 vitro functional assays, namely adhesion and wound healing assays.

Conclusions: 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 2.7 µg/ml. Apoptosis 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 vitro functional assays, namely adhesion and wound healing assays.

Multicolor flow cytometry-based cellular phenotyping identifies osteoprogenitors and inflammatory cells in the osteoarthritic subchondral bone unit
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Dr. Manuele Muraro, Universitätsspitäl Basel, Basel/CH;
PD Dr. Geert Pagensert, Universitätsspitäl Basel, Basel/CH;
PD Dr. Thomas Hügler, Universitätsspitäl Basel, Basel/CH;
Dr. Jeroen Geurts, Universitätsspitäl 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

Do we really know corrosion phenomenon of COCrMo alloy TKA?
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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 surgery. In the second group, patients had already a TKA implant and synovial was extracted during the beginning of the knee arthroplasty surgery. 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 with osteoarthritic stage III and IV before a total knee arthroplasty surgery was established with precision and signal stability. Corrosion rates appeared to be larger than expected until now. Comparison with bovine call 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.
Increased subchondral bone loss but lack of cartilage damage in a mouse model of premature aging due to mitochondrial DNA mutations

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Background: Animal models with mitochondrial DNA (mtDNA) mutations undergo premature aging 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 aging due to the expression of a proofreading-deficient version of the mtDNA polymerase γ (POLG).

Methods: 16 mice, of those 7 wildtype (wt), 5 heterozygous +/-D257A and 4 homoygous D257A/D257A were investigated by histology. OARSI score was applied and osteoclast activity was assessed by TRAP staining.

Results: Compared to the wild type, OARS 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 subchondral bone plate and trabecular bone structure was significantly thinner in D257A/D257A than heterozygote or wt (p <0.05) indicating osteopenia. TRAP activity was significantly 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. Osteoarthritis hyperactivity as occurring in this premature aging mouse model likely requires additional mechanical factors to induce osteoarthritis.
assessed with immunoblotting. Statistical significance was assessed with a repeated ANOVA and localized with a post-hoc test of Fisher.

Results: Body weight-related soleus mass demonstrated a trend (p = 0.10) for an increase in mock controls 4 days after tenotomy but 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.

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. The identification of 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.

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<Scanco 1176=Scanco vivaCT; whole body: Quantum FX<Scanco 1176=Scanco vivaCT<Scanco vivaCT(CT), spatial resolution (knee joints: Scanco vivaCT>Scanco 1176=SkyScan); lungs: SkyScan 1176>Quantum FX>Scanco vivaCT=Scanco vivaCT n.a.) and dosimetry (Quantum FX<Scanco vivaCT<Scanco 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.

Metastasis suppression via interruption of the CXCR4/SDF-1 chemokine axis in osteosarcoma
Olga Neklyudova/CH; Matthias Artt/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 intracellurally 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 caliper 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 was consistent with a compromised metastatic 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 tumor 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.

Sunitinib malate inhibits tumor growth and lung metastasis in an intratibial mouse model of osteosarcoma
Ram Kumar/CH; Matthias Artt/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 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 39.46 ± 20.23 mm³, respectively. Oral administration of 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 ± 73.1 mm³ while those mice which received 40 and 80 mg/kg was 50.30 ± 36.63 mm³ and 39.46 ± 20.23 mm³, respectively. Oral administration of Sunitinib malate inhibits tumor growth and lung metastasis in an intratibial mouse model of osteosarcoma
Ram Kumar/CH; Matthias Artt/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 carbonic anhydrase II 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 ± 73.1 mm³ while those mice which received 40 and 80 mg/kg was 50.30 ± 36.63 mm³ and 39.46 ± 20.23 mm³, respectively. Oral administration of
suninibin 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 suninib treated mice, the mean numbers were 118.1 ± 35.83 and 35 ± 11.7 respectively. The number of micrometastases (diameter >0.1 mm) was significantly higher at a mean number of 40 ± 4.5 in control mice when compared to macrometastases for 40 mg/kg (10 ± 4.5) and 80 mg/kg (3 ± 6.7) suninib treated mice.

Conclusions: Here, we demonstrate that Suninibin 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.

Introduction: Osteosarcoma (OS) is the most common primary malignant bone tumor in adolescents. The incidence rate is 0.1 to 1.0 per million of the general population. OS is a highly aggressive tumor with a high rate of mortality. Despite treatment with chemotherapy and surgery, OS has a low survival rate of around 60% at 5 years. The so-called ‘vicious cycle’, previously proposed to play a role in other bone-homing tumors also plays an important role in osteosarcoma. The cell cycle of bone-forming cells is necessary for bone remodelling. As these two classes of compounds modulate leading to a significant reduction in tumor growth and tumor associated bone remodelling, as these two classes of compounds modulate leading to a significant reduction in tumor growth and tumor associated bone remodelling.

Methods: We have 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 unencumbered osteoblasts. 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.

Prospects of 3-D printing in orthopedics
Dr. Darius Marti, HFR Fribourg – Hôpital Cantonal, Croessier/CH; Prof. Dr. Emanuel Gautier, HFR Fribourg – Hôpital Cantonal, Fribourg/CH; Lima Sottaz, Université Basile, Villars-sur-Glâne/CH

Introduction: Three-dimensional printing (3DP) also known as rapid prototyping or additive manufacturing is a versatile 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 have 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 unencumbered osteoblasts. 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.

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 A receptor (ActriA-hFc) 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 ActriA-hFc are illustrated by WB. Osteolytic effects were measured by bone resorption assay, in vivo- 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, ActriA-hFc, or ZOL. Tumor volume change was measured by caliper, tumor associated bone remodelling 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%, ActriA-hFc –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 indicates that activin inhibitors or 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.

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 tendon 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 tendons were 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 classifications 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 128%) 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 overstressed tissue response, resulting in poor histological differentiation, poor biomechanics, and, most importantly, potentially severe complications such as intratensive 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.
Predicted muscle recruitment depends on the critical shoulder angle – first insights using standard numerical algorithms for muscle recruitment

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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 pathophysiologcal ranges (28°–38°) had smaller than expected effects on predicted abductor activity. CSA influenced predicted rotator cuff muscle activity (Maxa = 8.8%, 15.7%), as did varying predicted recruitment cost (Maxa = 12.1%, 21.5%). 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 associated co-contraction or antagonist recruitment (Maxa = 27.9%). This 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 study aims to study 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 modified muscle recruitment patterns.

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

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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) 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 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/m² 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 tertiles 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-injury illnesses. The increased levels of the COM and hsCRP levels after marathon may suggest a role of inflammatory processes in stress-induced cartilage metabolism during recovery.


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

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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, and multiple logistic regression analysis to adjust for age and sex. P-values <.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.

Burn out among the orthopaedic surgeons in Switzerland

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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 that 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 protective or predicting 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...
Responsiveness and ceiling effects of the Oxford Hip Score and the Forgotten Joint Score – 12 in patients after total hip arthroplasty

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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 29.5) 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. 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.

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.
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.