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FM1

Influence of vastus medialis obliquus deficiency on patellar bone strain after in TKA

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Introduction: The causes of anterior knee pain (AKP) after TKA with non-resurfaced patella remains unclear. Weakness of Vastus Medialis Obliquus (VMO) has been frequently associated with patellofemoral pain (PFP) syndrome. It has been shown that VMO weakness may lead to the patellar maltracking. However, there is limited knowledge of its influence on the strain state of the patellar bone. Strain can be used to assess tissue damage. Furthermore, changes in strain state can influence the metabolic activity of the bone cells that are known to be mechanosensitive. This bone remodeling activity may be linked with AKP. In this study we assessed the influence of VMO deficiency on the strain state of the patellar bone using 3D musculoskeletal and numerical model of the knee with a TKA with non-resurfaced patella.
Methods: A subject-specific 3D musculoskeletal numerical model of the knee after TKA with a non-resurfaced patella was developed from CT sequences of a cadaver. The model included the femur, the tibia, the patella with cartilage and the four heads of the quadriceps. A postero-stabilized knee prosthesis was inserted under supervision of a knee surgeon. The patellar bone was modeled as linear elastic material with non-homogeneous mechanical properties extracted from CT data. A loaded squat movement controlled by the elongation of the Vastus Intermedius (VI) was simulated from full extension to 90° of flexion. Forces in the muscles were assigned proportional to their ratios found in literature. Two situations were compared: a normal and a deficient VMO. Deficiency of VMO was simulated by reducing its ratio by 50%. In the superior-posterior quarter of the patella, two regions of interest (ROI) were defined: medial and lateral. Octahedral shear strain volume of strained bone were predicted and compared in these 2 ROI for the normal and deficient VMO.
Results: Since the patellar bone experienced relatively small strains below 70° of flexion, the comparison was performed from 70° to 90° of flexion. The volume of highly strained bone in the lateral part of the patella was 2-fold larger in the case of VMO deficiency than for a normal VMO. Conversely, it was twice smaller in the medial part for deficient VMO than for a normal VMO. The medial side of the patella experienced higher strains than the lateral side, in both cases.
Conclusions: Deficiency of VMO caused increased bone strain in the lateral part and decreased strain in the medial part of the patella. Increased bone strain may be associated with anterior knee pain development.

FM2

Radionuclide Bone Scintigraphy accuracy in the detection of aseptic loosening of total knee arthroplasty

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CHUV

Introduction: Aseptic loosening is the major cause of total knee arthroplasty (TKA) revision and is widely investigated pre-operatively by radionuclide bone scintigraphy. However literature about the accuracy of this tool is scarce. Our purpose was to evaluate the validity of radionuclide bone scintigraphy in the detection of aseptic loosening of TKA using intra-operative findings as a gold standard.
Method: Retrospective study of 31 radionuclide bone scintigraphies performed on our patients prior to surgical TKA revision. All blinded examinations were interpreted by two experienced nuclear medicine physicians and the interobserver agreement was determined by κ statistics. Sensibility, specificity and accuracy of radionuclide bone scintigraphy for detecting TKA loosening was assessed using intra-operative findings as the reference.
Results: Thirty one patients were included in the study. The mean patient age at the time of surgical revision was 70.1 ± 10.0 years. Radionuclide bone scintigraphy and surgical revision were respectively performed 4.7 ± 4.1 years and 5.4 ± 4.1 years after primary TKA. The sensibility, specificity and accuracy of radionuclide bone scintigraphy for detecting TKA loosening, respectively, were 70.6%, 60.5% and 63.3% for reader 1 and 100%, 41.9% and 58.3% for reader 2. Separate analysis of femoral and tibial components showed that the tibial plate had the poorest accuracy in both readers.
κ value of 0.38 reflected a fair agreement between both nuclear medicine physicians.
Conclusion: Radionuclide bone scintigraphy reliability for detecting aseptic TKA loosening was low and the interpretation of the images was partially interobserver dependent. Therefore, surgical revision of a TKA should not be initiated only on the basis of this examination and new tools have to be developed in the future.

FM3

Revision of UKA: Is There a Difference Compared to Primary TKA and Revision TKA?

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Introduction: Unicompartimental knee arthroplasty (UKA) is an alternative procedure to total knee arthroplasty (TKA) for the treatment of osteoarthritis localized to one compartment. Nevertheless, because UKA procedures are rising, revisions of UKA are also increasing. In the literature, revision of UKA is presented less difficult than revision of TKA and results after revision of UKA are better than after revision of TKA, but worse than after primary TKA, but there is no study which compares directly results for these 3 categories of patients. Therefore, we aimed to compare in this monocentric study the patient function, quality of life and complications of revision UKA versus primary TKA and revision TKA.
Materials and Methods: This retrospective study reviewed patients operated for revision of UKA with TKA in our institution between 1998 and 2009. On 54 UKA (54 patients) revised by a TKA (Group R-UKA), 48 patients have been included in our study. 5 patients were lost of follow up and 1 patient died at 7 months after surgery without local complication of the prosthesis. This group of patients has been matched with 2 other groups regarding age, sex and BMI: one group of primary TKA (Group P-TKA) and one group of revision of TKA with TKA (Group R-TKA). Cemented implants were used in the three groups with standard PS implants in the P-TKA group, and PS augmented implants in the R-UKA group in 59% of the cases and in 100% in the R-TKA group. At last follow-up patients were analyzed clinically and radiographically with the KOOS, the Charnley score and the Knee Society (KS) Score by an independent observer.
Results: At a mean follow-up of 8 years (2 to 14 years) after revision, the improvement of the KSS was comparable in the two groups R-UKA and R-TKA, but results were better in the group of primary TKA. At the last follow-up, 56% of patients presented a B or C Charnley's category in the two groups R-UKA and R-TKA while only 20% of patients in the group P-TKA were B or C. Range of motion was 104° in the group R-UKA, 102° in the group R-TKA and 125° in the group P-TKA ($p < 0.001$). Results of the five items of KOOS were statistically comparable in the two groups R-UKA and R-TKA, but worse than in the group P-TKA. We observed more complications in the groups R-UKA and R-TKA than in the group P-TKA.
Discussion and Conclusion: Even if a revision of UKA is technically less complicated, results of our study show that functional scores and rate of complications after revision of UKA are worse than a primary TKA but are comparable to a revision of TKA. UKA is a bone preservative technique but surgeons cannot advocate that results of revision will be as good as a primary TKA.

FM4

Gait analysis and patients outcome after TKA comparing dependent vs. independent bone cut technique: A preliminary study

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Introduction: Total knee arthroplasty (TKA) can be performed using independent or dependent bone cuts. While with the first technique the ligament balancing is performed after all bone cuts were made, with the latter technique bone cuts rely on the first cut after adequate ligament balancing. The hypothesis is that patients operated with dependent bone cuts have a better stabilization of the knee in flexion. Therefore, the aim of this study was to determine if the use of a bone dependent technique has an influence on patients' outcomes in terms of biomechanical gait, pain, function, quality of life and satisfaction following TKA.
Materials and Methods: Forty patients (69 ± 7 years old; 24 women / 16 men) were evaluated before (V1), three months (V2) and one year (V3) following a primary TKA using the same implant (P.F.C.® Sigma®, DePuySynthes Orthopaedics, Warsaw, USA). Thirty patients were operated using independent bone cuts (group 1). Ten patients were operated using the dependent bone cuts using the Specialist® TRAM (DePuy France S.A.S., Saint-Priest, France) for a ligament balancing technique (group 2). A three-dimensional motion analysis system was used to measure the gait of individuals in terms of spatio-temporal, kinematics and kinetics parameters. The pain and functional levels were assessed using the Western Ontario and McMaster Universities Arthritis Index (WOMAC); the quality of life was assessed by the SF-12 questionnaire. The global satisfaction of patients as well as their satisfaction related to pain and functional levels were evaluated

at each follow-up evaluation using a 5-Likert scale (very unsatisfied; unsatisfied; neutral; satisfied; very satisfied). To evaluate patients' evolution, repeated measures ANOVA were performed using surgical techniques as the categorical predictor factor.
Results: No significant difference was found between both groups of patients in terms of age, body mass index, pain and functional levels at baseline evaluation. Moreover, no surgical technique effect was observed for biomechanical gait and clinical outcomes as well as for patients' satisfaction level at both follow-up evaluations. However, considering all patients (i.e., groups 1 and 2 combined) a significant increase of the gait velocity (V1: 1.07 m/s; V2: 1.08 m/s; V3: 1.19 m/s) was found at one year following TKA compared with preoperative and the early follow-up evaluations. Maximal knee flexion was also significantly improved at one year following TKA compared with early follow-up (V1: 46°; V2: 45°; V3: 48°). In addition, significant improvements were observed for the mean scores of the WOMAC (pain & function) at both follow-up evaluations. Finally, patients reported to be satisfied to very satisfied at one year post-TKA in 82.5%.
Conclusion: In this preliminary study, our hypothesis was not confirmed. There was no significant difference between both surgical techniques in patients' outcomes following TKA. However, the assessment of gait, pain, and function at three months and one year following TKA demonstrated significant improvements. Further studies with a larger sample of patients and with the assessment of more specific outcomes are needed to confirm our results.

FM5

Short Term Outcome of Bi-cruciate Stabilized Total Knee Replacement measured using the Knee injury and Osteoarthritis Outcome Score (KOOS)

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Background: Total knee replacement is the gold standard treatment for patients suffering from advanced symptomatic knee osteoarthritis. The main goals of knee prosthetics are pain reduction and restoration of knee motion. New implants on the market such as the bi-cruciate stabilized Journey knee implant promise a reconstruction of a more physiological function of the knee with a close to normal range of motion and therefore higher patient satisfaction.
Purpose: The aim of this study was to analyze the patient-based Knee Injury and Osteoarthritis Outcome Score (KOOS) outcome after total knee replacement with the bi-cruciate stabilized Journey knee prosthesis.
Study Design: Prospective, consecutive case-series.
Patients: Ninety nine patients, who received bi-cruciate stabilized Journey total knee prosthesis between January 1st 2006 and May 31st 2012, were included in the study. All patients were operated by a single surgeon. There were 61.1% females and the overall average age was 68 years (range 41–83 years). Left knee was replaced in 55.6%.
Methods: The patients filled in KOOS questionnaire pre- and 1 year postoperatively. Range of motion (ROM) was studied preoperatively and at 1-year follow-up. The pre- and postoperative KOOS subscores and ROM were compared using the Wilcoxon signed rank test.
Results: There significant improvement of all KOOS subscores. Ninety percent of patients have reached the minimum of clinically relevant 10 points in symptoms, 94.5% in pain, 94.5% in activities of daily living, 84.9% in sports and recreation, and 90% in knee related quality of life. Postoperatively, the average passive ROM was 131° (range 110–145°) and the average active ROM 122° (range 105–135°). The highest correlation coefficients for ROM and KOOS were observed for the activity and pain subscores. Very low or no correlation was seen for sport subscore.
Conclusions: Bi-cruciate stabilized knee prosthetic offers a solid outcome at 1 year based on the results measured with the KOOS evaluation questionnaire. The Patients showed a generalized improvement in all domains measured in the KOOS of minimally 35, and up to over 52 points, which was statistically significant. Patients described the level of functionality close to double compared to the preoperative status. Despite the good to excellent patient-described results, studies show a high complication rate using the Journey knee implant.
Key words: total knee replacement; Knee Injury and Osteoarthritis Outcome Score; Journey; bi-cruciate stabilized knee prosthesis; short term results

FM6

5 years post-operative results of a new ultra-congruent postero-stabilized TKA with mobile-bearing using gait analysis

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Introduction: In order to address the more specific needs of the young and active patients suffering of severe knee osteoarthritis, a new total knee arthroplasty (TKA) has been designed. The FIRST knee prosthesis (Free Insert in Rotation Stabilized in Translation, Symbios SA) is an ultra congruent, postero-stabilized total knee arthroplasty with a mobile bearing expecting to reduce significantly polyethylene wear, to improve the range of motion and the overall stability of the knee while ensuring a physiological ligament balance. Gait analysis has proven to give really objective outcome parameters after lower limb surgery. Using an ambulatory device, our goal was to compare subjective and objective results of this new TKA with standard models used all over the world.
Materials and Methods: Clinical prospective monocentric cohort study of 126 consecutive patients undergoing a FIRST TKA for primary osteoarthritis. Mean age of the cohort is 69.7 ± 8.3 years (47–88) and mean BMI is 28.6 ± 5.6 kg/m^2 (18.7–69). Follow-ups of the study were done at 6 weeks, 12 weeks, 6 months, 1 year and 5 years. Data included subjective evaluations (EQ-5D and WOMAC scores), semi-objective questionnaires (KSS score and radiography evaluation of the position of the components, of the patella and any loosening sign) and objective gait parameters from 2 walking trials of at least 30 meters long, performed at different speeds with an ambulatory gait analysis system (Physilog®, BioAGM CH). The outcomes of 89 patients after 5 years of follow-up are reported here and compared to the results of a randomized controlled clinical trial performed in the same center just before this study comparing 29 NexGen® postero-stabilized TKA (Zimmer Inc) with a fixed bearing to 26 NexGen® postero-stabilized TKA with a mobile bearing using the same methods.
Results: Post-operative subjective and semi-objective scores (EQ-5D, WOMAC and KSS scores) are improved for all types of TKA ($p > 0.05$). FIRST 5 years mean results included VAS 1.45 (SD 2.03), KSS function 83.64 (SD 20.46), KSS operated knee 87.78 (SD 13.10) and EQ-5D 73.31 (SD 18.20). No radiological loosening was observed in the FIRST implants cohort after 5 years of follow-up.
As for the ambulatory gait analysis, the comparison of several temporal and spatial gait parameters at different walk paces (slow, normal and fast) showed significant differences between the 3 types of prosthesis in favour of the FIRST TKA in term of Gait cycle time (GCT) (s): 1.12 (SD 0,02), Limp (%GCT): 1.24 (SD 1.35), Stride length (m):1.37 (SD 0.02), Gait speed (m/s): 1.22 (SD 0.04) and Knee maximum rotation angular velocity (°/s): 363.35 (SD 10.11).
Conclusions: We present the updated results of a new total knee arthroplasty, based on an ultra-congruent, postero-stabilized and mobile bearing that showed very encouraging clinical outcomes: we confirm similar subjective and semi-objective results in comparison with widespread TKA designs but statistically significantly better objective gait outcomes after five years of follow-up for the FIRST TKA. The validity of these positive results will have to be confirmed by updating the results of the FIRST TKA in the future. To our knowledge this is the first study to report the complete outcome of a new TKA since its introduction using gait analysis.

FM7

Differences in patient characteristics prior to TKA between Switzerland and the US

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Introduction: Total knee arthroplasty (TKA) results, including patient-reported outcome measures (PROMs), complication rates, and specific implant survival rates are often generalized across countries. However, patient- and environment-dependent factors may differ considerably between countries and continents resulting in differences in the longevity of specific implants and the national revision burden. Reports from national registries mostly lack detailed patient-information especially information on BMI, co-morbidities, pain and function level.
Objectives: Our objective was to describe and compare preoperative patient characteristics prior to TKA from two large cohort studies, one in Switzerland (with patient characteristics comparable to those reported in the Swedish and Danish registries) and the second a national cohort from the US.

Methods: Patient characteristics were collected prospectively on all elective primary TKAs performed (1) at a large tertiary center in Geneva, Switzerland between 1/2009 and 12/2011 and (2) in FORCE-TJR, a diverse, national sample of more than 100 surgeons in the U.S. between 6/2011 and 8/2012. Information was obtained on age, sex, BMI, diagnosis, medical co-morbidities (diabetes, cardiac disease and stroke), and patient-reported outcome measures including the WOMAC pain and function (reduced form-Swiss; estimated from KOOS-US), and a global health questionnaire, SF-12 (SF36/US) physical and mental component scores. Higher scores indicate less pain and better function/health. We calculated risk ratios, and mean differences, as well as effect sizes to compare preoperative scores.
Results: Overall, 2508 TKAs from the U.S. cohort and 855 TKAs from the Swiss cohort were evaluated. Patients undergoing primary TKA in the U.S. compared to those in Switzerland were younger (mean age 67 vs 72 yrs.; 23% US <60 years vs. 10% Swiss), more obese (BMI ≥35: 27% vs 17%), and had more cardiac disease. Patients in the U.S. had higher preoperative WOMAC pain scores (52 vs 41 points) indicating less knee-specific pain at time of TKA. While significant pre-operative physical disability (SF) was reported in both countries, the US reported poorer scores (33 vs 35).
Conclusion: We found substantial differences in baseline characteristics with younger age, greater obesity, and more cardiac disease in the US TKA patients. While preoperative knee pain was greater in the Swiss cohort, similar and significant disability was reported in both countries. Further research is needed to understand the differing pain reports. These findings have potentially important implications for the comparison of TKA results, especially complication and revision rates and postoperative clinical outcomes, reinforcing the need for adequate risk adjustment in cross-cultural comparisons.

FM8

Total Knee Arthroplasty: Do custom cutting blocks improve the clinical outcome of patients?

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Introduction: Anatomical reconstruction of limb mechanical axis is known to play a central role in longevity of total knee arthroplasty (TKA), particularly in young active patients. This is why TKA using custom made cutting blocks have been developed recently. The purpose of this study was to evaluate the mechanical axis reconstruction as defined by a CT-Scanner, together with the functional outcome and gait analysis, after a TKA implantation with 3D preoperative planning and custom instrumentation.
Methods: We prospectively followed a consecutive cohort of 103 patients who have undergone a posterior-stabilized TKA implantation with custom made instrumentation for primary knee osteoarthritis. Custom cutting blocks were manufactured using a preoperative CT-scan with a 3D planning of femoral and tibial bone cuts. Operative technique, implants and postoperative care were the same as those used for standard cuts in our department. The outcomes were measured using both clinical (WOMAC/ KSS) and radiological pre- and post-operative scores (6 weeks – 3 and 6 months – 1 year).
At one year we did CT-scanners to get precise implant position data, together with a gait analysis. Finally, the results were compared with those of our registry of 420 standards TKA.
Results: Patients had a mean age of 69.4 +/– 9.70 years. The clinical scores and the gait analysis did not showsignificant difference with those of the patients in our registry. However, the mean flexion range was 126.8° with the custom ancillaries in comparison to the 120.4 °of the patients in the registry, which is a clinically significant difference. The mean HKA measured on post-operative CT-scan was at 0.5° +/– 2.2 in comparison with the planned axis. The mean femoral varus-valgus was at 0.3° +/– 1.3, the mean femoral flexion at 2.1° +/– 2.2, the mean femoral axial rotation at 0.7° +/– 1.7, the mean tibial varus-valgus at 1.0° +/– 1.6 and the mean tibial slope at 0.0° +/– 2.5 in comparison with the planned values.
Conclusion: The range of flexion-extension was improved significantly in the group with custom ancillaries. The mechanical axis reconstruction and implant position appeared also to be improved by this new instrumentation in comparison with our knee implant register, with a reduction of the magnitude of the variations of the desired position of the implants.

FM9

Improved positioning of the tibial component in unicompartmental knee arthroplasty with patient-specific cutting

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Introduction: Unicompartmental knee arthroplasty (UKA) has undergone a recent resurgence in popularity. Numerous authors have cited alignment as an important prognostic factor in the survival of UKA. Limb alignment affects not only the longevity of UKA by increasing wear of the polyethylene, but also affects the unreplaced contralateral compartment. Malpositioning of the components produce unequal wear patterns, thus further leading to early failure and additionally influencing clinical outcome as well. Data shows in up to 100% a malpositioning of the tibial implant. With the introduction of patient specific instrumentation (PSI) this rate could decrease dramatically.
Objectives: This study is the first to investigate component alignment of medial UKAs implanted through a patient-specific cutting block technique.
Methods: We investigated pre- and postoperative CT-scans of medial UKAs implanted with patient-specific cutting blocks and compared the accuracy of postoperative outcome with the preoperative planning. We included 25 knees from 24 patients (10 male, 14 women, mean age 70 y, range 59–86 y). CT-scans were made from the operated knee pre- and postoperatively with additional images from the ipsilateral hip and ankle to measure the mechanical axis (HKA). Postoperative tibial varus/valgus, posterior slope and rotational alignment was measured through 3-dimensional reconstruction and compared to the preoperative planning. Additionally, we compared the HKA measured by CT-scans with conventional long-leg standing x-rays.
Results: Postoperative HKA showed mean values of 177° ± 2.8° (preoperative planning 175.4° ± 2.5°). The measurements of HKA with conventional x-rays showed comparable results with 177.3° ± 2.8°. The difference between the final bone cut compared to the preoperative planning showed for the tibial varus/valgus a mean of 0.5° ± 1.2° (2.9° ± 0.7 varus planned), for the tibial posterior slope 0.7° ± 2.0° (4.6° ± 1.3° planned), and for the tibial implant rotation a mean difference of 1.6° ± 3.5° external rotation (0° planned).
Conclusion: This study showes excellent results in rotational and varus/valgus alignment of the tibial implant in patientes undergoing medial unicompartimental knee arthroplasty. Considering the crucial role of correct alignment of implant positioning for the survival of UKAs, the patient-specific cutting block technique seems to be a promising technique to optimize implant positioning.

FM10

Unicompartmental knee arthroplasty after 85 years old

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Introduction: The unicompartmental knee arthroplasty (UKA) continues to gain popularity as a viable treatment option for arthritis isolated to one compartment. It has been reported to provide decreased perioperative morbidity, faster recovery, quicker and easier rehabilitation, and excellent longterm survival: these advantages may benefit octogenarians. Then we hypothesized that UKA is may be a viable alternative to total knee arthroplasty (TKA) as the definitive treatment of localized arthritis in patients over 85 years old.
Methods: From 1993 to 2011, patients over 85 years old with severe unicompartmental knee osteoarthrisis were included, even if mild patello-femoral osteoarthritis was present. Other inclusion criteria were: pre-operative hip-knee-ankle angle less than 10°, no ligament laxity, good range of motion (at least 90° of knee flexion and less than 5° of extension loss), no inflammatory joint disease. The main complaint was severe localized pain. UKA were implanted by a short medial arthrotomy for medial femoro-tibial arthritis, versus lateral arthrotomy for lateral femoro-tibial arthritis.
Results: UKA were implanted in 26 consecutive patients, representing 31 knees: 24 medial UKA and 7 lateral UKA. 92% of patients were females. All patients were 85 years-old or older (mean 87 y.o, range 85–91 y.o). Mean body mass index was 23. In the postoperative days, only one patient needed a blood transfusion, and none had deep venous thrombosis or infection. Knee Society knee and function scores improved at an average of 3.5 years follow up (range 1–10 years). 90% of patient were satisfied or very satisfied and would have surgery again. The mean postoperative knee range of motion was full extension and 130° of flexion. Only one of the 31 knees (3%) required revision surgery into total knee arthroplasty for an early implant failure. At final follow up, 8 patients (11 knees) had died with all having the index UKA in place and functioning well; mean postoperative survival was 5.4 years.

Conclusion: Although total knee replacement has proved to havea high success rate in elderly patients, UKA can be expected to provide reliable and durable results in certain patients of this age group. Lower morbidity and faster recovery after UKA may benefit octogenarians and UKA should be regarded as a definitive treatment option in appropriated selected patients over 85 years old.

FM11

10 year results of the tension controlled, ligament balanced total knee arthroplasty

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Introduction: Posterior cruciate ligament (PCL)-retaining prostheses are commonly used and give good outcomes. After 10 years of total knee arthroplasty (TKA) in situ wear, radiolucent lines and osteolysis become more frequent and are main reasons for TKA revisions. Only few long term data on soft tissue orientated surgical technique are currently available. This study investigated the 10 year results of primary TKA using the ligament balancing technique.
Methods: As part of a cross-sectional retrospective investigation this study evaluated the data on patients treated in 2 Swiss clinics with the first series of balanSys total knee prostheses (Mathys Ltd. Bettlach, Switzerland) using the soft tissue orientated surgical technique. Between 1998 and 2003, 408 cases (361 patients) were operated and received the implant with either a fixed (78.2%) or a mobile (21.8%) bearing polyethylene inlay. At the 10 year follow-up (FU) examination, range of motion (ROM), knee society score (KSS), visual analogue scale (VAS) for pain and satisfaction were determined and radiographs were evaluated. Safety evaluation included postoperative complications and revisions.
Results: Out of 408 cases, 137 were lost to FU due to death, 21 due to unknown address. In 43 cases a phone interview was done, 57 indicated at least if the implant is in situ. Finally, 128 cases (82 female; 46 male) performed the FU after 11.2 (±1.1) years. Patients' mean age at FU was 79.6 (±6.6) years. Mean total KSS was 155.8 (±25.9) points and mean passive flexion was 114.7 (±12.3)°. VAS mean scores for pain and satisfaction were 1.5 (±2.2) (best 0) and 8.7 (±2.2) (best 10), respectively. No radiolucent lines were found under the femoral and tibial component in 92.7% and 68.3%, respectively. Out of all implants 22 (15 mobile, 7 fixed bearing) were revised due to limited ROM (6), instability (4), infection (3), loosening (3), prosthesis size (2) or others (4). Only 18 minor complications were mentioned, e.g. fall (12), mobilisation under anesthesia (1), infection (1), others (4).
Conclusion: This study suggests that TKA's performed with the PCL-retaining prosthesis by using a soft tissue oriented surgical technique is a safe procedure and associated with very good long term results (KSS and VAS) as well as only few complications in this elderly population. Long term results of implants in combination with a specific surgical technique are needed to draw conclusions on the clinical outcome and safety.

FM12

Decision making for Surgery in Trochlea dysplasia – Lateral Trochlea Tilt!

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Introduction: The lateral trochlea tilt is a helpful tool for surgical indication in patellofemoral instability with trochlea dysplasia.
The patellofemoral instability becomes more understood in the last years. And still it is a phenomenon because of the multifactorial causality. Beside the muscular imbalance, abnormities in frontal (valgus/varus) or rotational axis, TTTG, MPFL tension, height and dysplasia of the patella is the Trochlea dysplasia one of the most challenging factors.
The current study aims to describe the measurements for the decision making if surgery for trochlea correction is necessary or less invasive surgery like MPFL reconstruction can be performed. To define the indication, after more than 20 years experiences in trochleoplasty, for this operation we created the lateral trochlea tilt measurement in addition to the classification according to D. Dejour.
Methods: We analysed in this retrospective cohort study MRI images from 30 knees with trochlea dysplasia and controlled this group with 60 normal knees without any patellofemoral symptoms. The two groups were matched regarding age, gender and the time the MRI was taken. The statistical analysis was performed with the Student's t Test. For reliability all MRI were seen and measured by two observers. As in the Dejour classification known is the central height in relation to the medial and lateral condyle characterising the dysplasia. We defined the lateral trochlea tilt as the angle from the centre of the trochlea to the lateral condyle border in relation to the posterior condyle axis on axial MRI views. Patients with retropatellar instability due to trochlea dysplasia had a significant lesser lateral tilt compared to the control group. We performed in all cases with trochlea dysplasie with lateral tilt less than 10 degrees a modified trochleoplasty. The followup was 1 year. No patient had in the first year after surgery a relapse of instability.
Conclusion: In conclusion the lateral trochlea tilt can be used as an indicator for different surgical treatments. In cases with an angle less than 10 degrees and without severe cartilage pathology do we recommend the trochleoplasty and in cases with instability and an angle >10 degrees soft tissue balancing with MPFL reconstruction.

FM13

The Architecture of the Quadriceps Tendon and its Insertion into the Patella

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Introduction: Published data regarding the structure of the quadriceps tendon (QT) is diverse; authors report observing between two and four layers. Closer inspection of the quadriceps group reveals an intervening muscle (IM) between the vastus lateralis (VL) and vastus intermedius (VI), which cannot be clearly assigned to the former or the latter. The IM was previously attributed to VL, hence its role in the structure of the QT is unreported. The aim of this study was to investigate the layers of the quadriceps tendon with special emphasis on all components of the extensor apparatus.
Methods: Ten cadaveric lower limbs from seven specimens were investigated using macros dissection techniques. All muscle bellies of the extensor apparatus were identified and traced distally until they merged into the quadriceps tendon. Connections between the different aponeurotic layers of each muscle were studied from origin to insertion focusing on corresponding muscle fibers from the medial and lateral elements. The main fusing points of each layer were marked and recorded. Their distance to the patella and the distances between the fusion points were measured.
Results: All portions of the quadriceps muscle were fused over a region measuring 1.3 to 9 cm (mean 4.4 cm, SD +/– 2.1) proximal to the patella. The deepest layer of the QT was formed by lateral portions of the VI. Fibers of the deep medial aponeurosis of the VI fused with fibers of the IM in the deep middle layer, on average 5.6 cm above the patella (range, 3.0 to 9.0 cm, SD +/– 21.1). From the medial aspect another layer of the medial VI was found, in the distal aspect this turned into a tendinous gliding layer of the vastus medialis (VM) and merged with the aponeurosis of the VL in the superficial middle layer 2.3 cm (range, 1.2 to 4.1, SD +/– 0.9) distal to the meeting point of the deep middle layer. The superficial middle layer was joined on average 3.3 cm (range, 1.3 to 5.3, SD +/– 14.1) above the patella. The superficial layer of the QT was formed by the tendon of the rectus femoris.
Conclusion: The quadriceps tendon is formed by five elements which join each other proximal to the patella like a corn husk. Depending on the level of incision of the QT, one finds two, three or four layers. This may have caused confusion in the interpretation of the layers of the QT in previous literature.

FM14

Measuring tibial torsion – evaluation of a new technique

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Introduction: To successfully plan a derotational osteotomy or to reduce a fracture of the tibia, an exact assessment of torsion is necessary. Measuring tibial torsion by CT imaging using the conventional methods of Jakob and Elgeti, rely on measuring the angle between the tibial plateau and the malleolar axis. The shortcomings of these approaches are, that the reference lines used are difficult to place, tibial dysplasia is not taken into account for and there is no possibility to determine the level of maltorsion. We hypothesize, that these shortcomings may be overcome by using two new reference lines along the medial cortex of the proximal and distal tibia.
Methods: A retrospective study was performed bilaterally on 30 torsional CTs, which were routinely made during 2011 and 2012 as part of our preoperative diagnosis (19 men and 11 women). The tibial torsional angle was measured between the proximal reference lines according to Elgeti (tangential to dorsal proximal tibial condyle) (PE) and to Jakob (transversing the widest part of the tibial plateau) (PJ) and distally using a transmalleolar reference line (DM). Two further reference lines were placed tangential to the medial cortex of the tibia. The proximal cortical tangent (PC) was placed just proximal of the tibial tuberosity, where the tibia flattens out. The distal cortical tangent (DC) was placed just proximal of the medial malleolus, where the tibia is still flat. Angles were measured between the reference lines and statistically analyzed.

Results: All results are in mean and standard deviation. Men were 39 ± 12 years and women 35 ± 13 years old. The mean external torsion using PE and DM was 34 ± 10.4° for the right side and 28.3 ± 8.7° for the left side. Using PJ and DM we found a torsion of 35.6 ± 11.5° for the right side and 29.3 ± 10.4 for the left side. Using the medial tibial cortices PC and DC a torsion of 20.0 ± 8.1° for the right side and 24.3 ± 8.7° were measured. The external torsion between PE and DC was 60.5 ± 8.4° for the right and 64.8 ± 8.1° for the left side.
Conclusion: Our measurements of tibial torsion using PEDM and PJDM reflect those of other groups (28.8° and 30° respectively). Measurements of tibial torsion using the PC and DC yield a smaller standard deviation, compared to measurements using PEDM and PJDM indicating a preciser, probably simpler measuring technique. The PC correlates well to PE and PJ, as does the DC to the DM, showing clinical relevance, as PE, PJ and DM are reference lines attempting to reflect the axis of articulation. As the PC and DC reference lines are tangents along the medial tibial cortex, which may be easily appreciated in clinical examination, they may offer additional information to torsion without using radiography. Although the PC and DC reference lines do not reflect an axis of articulation, they may be useful to find the correct torsion during surgery, where determination of torsion may be difficult.

FM15

Factors influencing posterior tibial slope and tibial rotation in opening wedge high tibial osteotomy: A cadaveric study

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Introduction: Opening wedge high tibial osteotomy (HTO) is an accepted treatment option for medial compartment knee osteoarthritis with associated varus lower limb axis in younger, more active patients. A concern with the use of this technique is that posterior tibial slope (PTS) and tibial rotation can be altered.
Methods: A cadaveric model and surgical navigation system were used to evaluate the influence of certain intra-operative factors of the degree of PTS and tibial rotation change observed during medial opening HTO. Parameters evaluated included: degree of osteotomy opening, knee flexion angle, location of limb support (thigh versus foot), performance of a posteromedial release, the status of the lateral cortical hinge, and the degree of osteoarthritis present in the knee.
Results: Combining measurements of all specimens and parameters, a mean PTS increase of 2.7 ± 3.9 degrees and a mean tibial internal rotation of 1.5 ± 2.9 degrees were observed. Clinically significant changes in tibial slope (greater than 2 degrees) occurred in 50.4% of corrections, while significant changes in tibial rotation (greater than 5 degrees) occurred in only 11.9% of corrections. Patients with significant osteoarthritis and concomitant flexion contracture, cases where large corrections were required, and procedures in which the lateral cortical hinge was disrupted were associated with increased PTS change. The other factors evaluated did not exert a significant influence of the degree of PTS change observed.
Conclusion: Surgeons should be vigilant for possible PTS change, particularly in high-risk situations as outlined above. We recommend routine use of an intra-operative measure of PTS to avoid inadvertent slope change.

FM16

A simple arthroscopic fixation technique of intercondylar eminence fractures in children without remaining artificial fixation devices

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Introduction: Growth disturbances are the main fear while treating eminence fractures in children. Different epiphyseal sparing techniques are described to reduce this risk, but leaving non-resorbable screws or sutures necessitate removing. The purpose of this study was to compare an established fixation technique with one using absorbable threads and transosseous fixation without compromising the physis.
Methods: We retrospectively analyzed 11 cases (McKeever Type II or higher) since 2005 treated with either non-absorbable thread fixation and tibial screw fixation (Group A, n = 5, mean age 13.2 years, mean follow up 58.2 months) or with absorbable thread and transosseos fixation (Group B, n = 6, mean age 12.0 years, mean follow up 20 months).
Results: No significant difference in both groups concerning function according to the IKDC (Group A: three A, two B, Group B: four A, two B), laxity or stability comparing the different operation techniques was found. Complete osseous integration of the fracture was achieved in every case within three months. Lysholm score in Group A was 86.9 (range 68–100), in Group B 92.8 (range 70–100) with no significant difference. There was no significant difference in ACL side to side laxity in every case.
Conclusion: Treatment of intercondylar eminence fracture with absorbable thread and extraarticular transosseous fixation is simple and leads to a high rate of good results. Furthermore there is no need for metal removal and no persistent artificial material within or about the knee joint.

FM17

Managment of Schatzker VI tibial plateau fractures: Case series and review of literature

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Introduction: Management of high energy intra-articular fractures of the proximal tibia is a challenging condition.The treatment of such fractures, need to pay specific attention to the soft tissue envelope around the knee with an acceptable reduction. They are only a few papers in the literature concerning the hybrid external fixation method treating this type of fractures.
Methods: We present a case series of 5 patients were admitted to our hospital, a level I trauma centre, with a closed Schatzker VI tibial plateau fracture between march 2010 to november 2012. All patients were treated with a hybrid external fixator (Tenxor Stryker-Howmedica) and the reduction was performed most often by closed means or through mini-open reduction Mean follow-up was 23.5 months (range 7 to 32 months) and were evaluated with radiographs.
Results: In 2 cases the hybrid fixation was the final treatement and in 3 cases we removed thetemporary hybrid fixation which was followed by re-osteosythesis by LCP plate. Radiographic evidence of union was observed at 5.8 months (range 3 to 9 months). No pin track infection was observed.
Conclusion: We found the hybrid external fixation method as a suitablae solution for closedSchatker VI tibial plateau fractures in terms of radiologic consolidation with acceptable reduction. It can be used as a final solution or as temporary fixation followed by removal and re-osteosythesis by plate. It has theoretical advantages in terms of the soft tissues but the benefit over internal fixation has not been yet demonstrated in terms of improved outcome in the literature.

FM18

Cerebral activation related to shoulder apprehension in patients with glenohumeral instability and in healthy volunteers

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Introduction: Apprehension is the most frequent complaint of patients after traumatic anterior glenohumeral dislocations [1]. Also, some patients have persisting apprehension even after successful open or arthroscopic stabilization [2–5]. It is not always clear whether the origin of apprehension is true instability or whether it stems from a cerebral pattern linking a certain motion or position to a subjectively unpleasant sensation. Failure to recognize and adequately address this issue of persisting apprehension due to cerebral patterning may result in poor outcomes and even lead to unnecessary revision surgery. Furthermore, identifying this condition may allow establishing adequately targeted rehabilitation protocols.
Functional magnetic resonance imaging (fMRI) is a powerful tool to assess neuronal activations during numerous situations. To date, no investigation has assessed the neuronal correlates of shoulder apprehension.
Hypothesis: Apprehension is consecutive to brain activation and cerebral remodeling. Shoulder instability could lead to cerebral reorganization and thus, apprehension could persist even in the case of a mechanically stable glenohumeral joint. Therefore, in some cases, the sensation of apprehension could be linked to abnormal cerebral conditioning and not necessarily to persisting instability.
Purpose of the study: The purpose of the study was to localize the zones of cerebral activation and to investigate neuronal activation patterns using event-related fMRI while the subjects are visualizing provocative videos depicting situations stimulating apprehensive reactions.
Materials and methods: Multimodal neuroimaging including functional connectivity, grey matter (GM) and white matter (WM) morphometry was used to assess the unexplored neuronal mechanism mediating shoulder apprehension. This prospective study included 7 consecutive right-handed male patients with right-sided shoulder apprehension (30.1 ± 8.1 years) and 11 healthy male right-handed control participants.
MR protocol: A video projector was used to project the stimuli onto a translucent screen mounted to the table of the MR imager. Stimuli were seen via mirrors on the head coil. Each run consisted of twelve movies evoking shoulder instability and twelve control movies. Multimodal analyses include functional connectivity tensorial independent component analysis during visual stimulation of movies showing typical apprehension movements versus control videos, voxel-based morphometry analysis of GM and tract-based spatial statistics analysis of WM.
Results: Patients with shoulder apprehension had cerebral remodeling with significant ($p < 0.05$ corrected) increase in functional connectivity notably in the ipsilateral motor area (Smode +151%, component 16) and less pronounced in anterior (Smode + 131%, component 19) and posterior (Smode + 41%, component 10) parts of the default mode network despite the absence of potentially confounding structural changes in GM or WM.
Discussion: Shoulder instability is often associated with peripheral nerve injury. This is the first study that demonstrates that a peripheral orthopaedic pathology could also lead to a central neurological impairment. Shoulder apprehension induces functional reorganization of the brain with notably up-regulation of ipsilateral motor areas as well as alteration of the default mode network. This premier observation offers novel insights into the neuronal effects of shoulder instability which could, with future studies, be generalized to other joints. These original findings may open new horizons leading to improved management regimens for articular instability.

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FM19

Suture Anchor Fixation of Bony Bankart Fractures: A Comparison of Single Row versus Suture Bridge Techniques

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Introduction: Multiple techniques exist for arthroscopic suture anchor fixation of small bony bankart fragments; however, there is little evidence supporting a preference for one technique. As an alternative to the standard single row suture anchor technique, a suture bridge technique has been described. While the standard technique a single loop passes around the bone fragment, the suture bridge technique places an anchor at the articular margin of the defect and second medial to the fragment on the anterior glenoid vault with sutures passing from the medial anchor over the bone fragment to the lateral anchor. The objective of this study was to compare the fixation stability, strength and load transfer of these techniques.
Methods: Sixteen shoulders (8 pairs) were tested with an intact glenoid, after creating a 15% bony bankart lesion and after fragment fixation using a single row or suture bridge technique. Paired specimens were randomly assigned to each technique. Cyclic loading was applied to the glenoid concentrically and then eccentrically according to a 7 step staircase protocol. Fragment displacements, failure strength, glenoid strain load transfer and contact area were quantified.
Results: Centralized loading produced significant differences in fragment displacement at 5, 150, and 200N ($p \leq 0.045$) and approached a difference at 50 and 100 N ($p \leq 0.061$). In all cases the single row technique permitted greater translation, ranging from 0.06–0.28 ± 0.07–0.32 mm. Eccentric loading caused significantly greater fragment displacement in the single row group for all loads above 25N as compared to the suture bridge (mean range, 0.38–0.63 ± 0.23–0.28 vs. 0.14–0.19 ± 0.11–0.27 mm, respectively ($0.009 \leq p \leq 0.048$)). Load transfer measurements did not differ between techniques ($p \geq 0.318$), nor between the suture bridge technique and the intact glenoid ($p \geq 0.181$); however, single row strain results approached a difference to intact at 5, 10 and 25N ($p \leq 0.072$). No significant differences in failure strength were found between the two techniques (mean strength, single row: 74 ± 28N versus suture bridge: 77 ± 56N, $p = 0.91$).
Conclusion: Interface displacement results demonstrate that the suture bridge technique provides significantly greater fracture fragment stability; however, it does not increase failure strength Thus, the suture bridge technique provides improved initial fragment stability; however, its overall strength is comparable to the single row repair.

FM20

In anterior shoulder dislocations the degree of displacement of the humeral head correlates with rotator cuff tears

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Introduction: Rotator cuff tears (RCT) are a well-known complication of anterior shoulder dislocations. Several studies have shown that the incidence increases with increasing age. We hypothesized that the risk of a tear also increases with the degree of dislocation of the humeral head.
Methods: Three independent observers retrospectively reviewed the charts and initial x-ray pictures of 155 consecutive patients with a traumatic first time anterior shoulder dislocation. The severity of dislocation was graded according to the position of the humeral head relative to the glenoid plane on standard anteroposterior x-ray pictures: grade I) the geometric center of rotation (CR) of the humeral head is lateral to the glenoid plane; grade II) the CR is in the plane of the glenoid; grade III) the CR is medial to the plane of the glenoid; grade IV) the entire humeral head is medial to the plane of the glenoid. The reliability of the classification system was assesses using an intra-class correlation ICC(2,k). A multivariate logistic regression model was used to reveal relevant predictors for RCT. The analyzed co-variates were age (</≥45y), gender(m/f), side(r/l), greater tuberosity fractures(y/n), glenoid fractures(y/n), neurologic lesions(y/n), and the grade of dislocation.
Results: The ICC showed a high reliability (0.93). The proportions of RCT for grades I-IV were 8%, 19.3%, 36.7% and 62.5%, respectively. The adjusted regression analysis showed that patients with a grade III dislocation had an 8.5-time (KI95% 1.5–47.3) and patients with a grade IV dislocation a 19.9-time (KI95% 2.9–135.2) higher likelihood for a RCT compared with patients with a grade I dislocation. Additionally, patients older than 45 years had a 2.9-time (KI95% 1.2–7.4) higher likelihood and patients with a greater tuberosity fracture a 0.16-time

(KI95% 0.05–0.47) lower likelihood for a RCT than younger patients and patients without a fracture, respectively.
Conclusion: The proposed classification system is reliable and helps to identify patients at risk for a rotator cuff tear after a first time anterior shoulder dislocation.

FM21

Clinical and radiological results following arthroscopically assisted stabilization of acute grade III and IV AC joint separations

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Introduction: Persistent horizontal instability after an acute acromioclavicular (AC) joint separation may provoke unsatisfactory results of conservative treatment.
Hypothesis: The arthroscopically assisted double flip button stabilization of an acute grade III and IV AC joint disruption results in full functional restoration and stable radiological reposition.
Method: 21 patients who were treated for an acute grade III or IV AC joint separation were enrolled in this study and clinically evaluated using the Constant Score (CS) and the Simple Shoulder Test (SST). Functional outcome was tested for correlation with radiographic results.
Results: 19 individuals with a mean age of 37 years (17 men, 2 women) were available for clinical and radiological examination after a minimum follow-up of 24 months (range 24–51 months). From injury to surgery, the mean time interval was 12.5 days (range 4–21 days). According to Rockwood's classification 3 type III and 16 type IV injuries were treated. There was no statistically significant difference between the Constant Score of the study group and the age adjusted normative values. The mean Constant Score was 90.2 points (SD 3.4) and the mean Simple Shoulder Test scored 11.5 points (range 8–12). The overall satisfaction was 8.2 on the visual analogue scale. 16 patients would undergo the intervention again. The functional outcome of these patients was not affected by the radiographic findings. Complications occured in 4 cases and were treated surgically in 2 patients.
Conclusion: Patient satisfaction after arthroscopically assisted double flip button stabilization for acute grade III and IV AC joint separation is high. Clinical outcome shows similar results to age adjusted normative values. Loss of reduction is a radiographic finding in approximately one third of patients but not affecting clinical outcome.

FM22

Immobilization in internal or external rotation does not change recurrence rates after traumatic anterior shoulder dislocation

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Introduction: A major complication of anterior dislocation, and the main reason for subsequent shoulder instability, is damage to the anterior tissues of the shoulder, specifically the anterior-inferior labrum and/or glenoid rim, better known as a Bankart Lesion. If this lesion heals, as it does in 50% to 80% of all patients, recurrent dislocations are less likely. In 1999 Itoiet al. made an argument that immobilization in external rotation would reduce damaged anterior-inferior tissues to the glenoid via ligamentotaxis, improve the healing rates of Bankart-type lesions, and thus result in a reduction of recurrence rates. A number of randomized, controlled trials have tested this theory, but have reached conflicting results. It is the objective of this study to systematically review and quantitatively synthesize the data on recurrence rates after shoulder immobilization in internal versus external rotation in first time, traumatic dislocators.
Methods: We performed a systematic search of the keywords "(external rotation OR internal rotation AND immobilization AND shoulder)" in the online databases PubMed, EMBASE, CINAHL, and the Cochrane Library.
Internal validity was assessed using a modified Jadad scale,which ranges from 0 points (poorest result) to 3 points (best result), attributing 1 point for each randomization, blinding, and attrition Publication bias among the included studies was assessed graphically using Egger's regression.
The presence of between-study heterogeneity was qualified by Cochrane's Q test.
Random effect models were used to calculate the cumulatively pooled risk ratios (RR) of recurrent shoulder dislocations. All analyses were also stratified by age.
Results: Our search strategy generated 254 studies online and by citation tracking. After exclusion of duplicates, studies not focusing on clinical treatment or outcome, animal studies, studies without any intervention and one study with unacceptable high attrition, five studies including 471 patients (n = 230 in internal rotation and n = 241 in external rotation) remained for analysis. The included studies were published between 2001 and 2011 in English.
The mean Jadad score for the included trials was 1.6 points (95% confidence interval 0.6 to 2.6) points).
There was no evidence for publication bias (p = 0.252) in Egger's regression.
Between studies heterogeneity was borderline significant (p = 0.055) with an I^2 index of 56.7%.
The pooled, cumulative, DerSimonian-Laird random effects risk ratio (RR) for recurrence of shoulder dislocations at all ages was 0.74 (95%CI 0.44 to 1.27), not consistent with a statistically significant difference (p = 0.278) (figure 2). The post hoc power for this inference test was 94.5% In the meta-regression we found a significant influence of age on the risk ratio (p = 0.003).
The pooled, cumulative, DerSimonian-Laird random effects risk ratio (RR) for recurrence of shoulder dislocations for patients aged 30 years or younger ages was 0.70 (95%CI 0.38 to 1.29) (figure 3). Again this risk ratio was not significant (p = 0.250) with a power of 99.8%.
The pooled, cumulative, DerSimonian-Laird random effects risk ratio (RR) for recurrence of shoulder dislocations for ages 30 and higher was 0.78 (95%CI 0.32 to 1.88) at a p-value of 0.579, but with a power of only 12.2% (figure 4).
Conclusion: The currently available best evidence does not support a relative effectiveness of immobilization in external rotation compared to internal rotation in reducing recurrent shoulder dislocations in patients with traumatic anterior shoulder dislocations. However, after reviewing the current clinical data and the available basic science it is our opinion, that yet to be determined subgroup of patients could benefit from such treatment. Future investigations are needed to test this hypothesis.

FM23

Use of autologous segmental bone graft for large humeral head defects after posterior shoulder dislocation

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Introduction: During posterior dislocation an osteochondral impression fracture of the anteromedial humeral head is produced. Engaging defects predispose for recurrent instability and require reconstruction of the humeral head contour. The McLaughlin procedure or the transfer of the lesser tuberosity is recommended for defects between 25 and 40%. These procedures may limit internal rotation and impair humeral head circulation. For larger defects, the use of allograft has been advocated. However, there are concerns about availability and transmission of viral infections. In this case series, clinical and radiological results with the use of autologous segmental cortico-cancellous bone from the iliac crest were assessed.
Methods: Three patients (age 43, 57, 63) with locked traumatic posterior shoulder dislocations were retrospectively reviewed. The osteochondral lesions measured on axial CT involved more than 40% of the joint surface (45, 50, 55%). They were treated by open reduction and reconstruction of the anteromedial head lesion by two segments of cortico-cancellous bone from the iliac crest. The grafts were fixed with screws. Congruency of the humeral head was achieved in all cases. One patient needed ORIF of a concomitant humeral head fracture. There were no complications from the donor site.
Results: At a mean follow-up of 23 months (10, 11, 50) no redislocations occurred. There were no radiological signs of osteoarthritis (according to Samilson and Prieto) or osteonecrosis. Mean absolute Constant score was 86 (76, 88, 96), mean relative Constant score 94 (86, 95, 100), mean subjective shoulder value 83% (80, 80, 90). Maximal abduction was 140–170°, flexion 145–160°, external rotation 35–45°, internal rotation ranged from lumbar 3 to thoracal 12. One patient (age 63) was free of symptoms after bursectomy and removal of two screws one year after reconstruction. The other two patients returned to work within two months and had no limitations in their daily life.
Conclusion: Large bony defects of the humeral head after posterior dislocation require reconstruction. In the literature several surgical procedures are described. This small case series presents mid-term results of anteromedial humeral head reconstruction with the use of autologous cortico-cancellous bone graft. The clinical and radiological outcome is comparable to the results achieved by allograft in terms of subjective satisfaction, range of motion and resumption of daily life.

FM24

Anatomy of the humeral insertion of the supraspinatus

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Introduction: The rate of severe degenerative changes of the supraspinatus varies between 30 and 45%. No other tendon in the human body has such a rate of degenerative tear.
Many authors demonstrated that most of the lesions appear at the deep surface of the supraspinatus. An anatomical and biomechanical research has been undertaken to try to explain the cause of the supraspinatus lesion.
Material and methods: 20 shoulders from fresh human cadavers were dissected. The patterns of insertion, the course of the tendon and the variations of the orientation of the fibers at the level of their bony attaches were studied during the movements of scapulohumeral joint.
Results: In most of movements studied the humeral head worked as a pulley for the subscapularis and infraspinatus tendons. As a consequence there was very little change at the level of the tendon's attaches. Study of the supraspinatus tendon evidenced absence of pulley effect leading to huge plication and torsion of the fibers.
Ninety degrees abduction of the arm with neutral rotation led to a 90° plication of the supraspinatus tendon. In the same way 90° internal rotation didn't change anything to subscapularis and infraspinatus tendons whereas the same amount of rotation was measured for the supraspinatus.
Discussion: These results strongly suggest that the attach of the supraspinatus sustains a huge range of plication and/or torsion by comparison with to the other cuff muscles that may explains the high rate of degenerative lesions.
Furthermore a more general anatomic study demonstrated that most of the tendons (with the noticeable exception of the brachial triceps and the Achille's tendons) in the human body are protected by pulley phenomenons that limits the range of plication at the attach.
Therefore, the anatomy of the supraspinatus attach is very peculiar regarding not only the cuffs tendon but also the whole body and may be an important part of the explanation of the high range of degenerative lesions.

FM25

The humeral head surface is not spherical

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Introduction: Anatomic shoulder prostheses with spherical heads very often do not perfectly cover the osteotomy surface of the anatomical neck. This may result in a prosthetic overhang anteroposteriorly with the risk of damaging the rotator cuff or an insufficient coverage of the metaphysis inferiorly with the risk of glenohumeral impingement, resulting in asymmetric loading and potential loosening of the glenoid component. The purpose of the present study was therefore to assess the geometry of the humeral head in order to improve the design of shoulder prostheses.
Material and Methods: Thirty-seven dry cadaver humerii without macroscopic lesions were included in this study. The bones were fixed in a custom made frame, with the humeral head surface pointing upwards and the anatomical neck in a horizontal plane. The anatomical neck, as well as the craniocaudal and anteroposterior meridians were marked with two cross line lasers and scanned with use of a hand held Microscribe 3D digitizer. The data were stocked and analyzed in Excel files.
Results: In all except one specimen the anteroposterior diameter was smaller than the craniocaudal diameter. The average difference between these two diameters was 2.7 mm (range: –0.3 mm to 6.1 mm, SD: 1.4 mm). This difference was statistically significant. The anteroposterior meridian had a smaller radius of curvature posteriorly than anteriorly, indicating an asymmetry of the humeral head in the transverse plane. Such a difference could not be found in the craniocaudal plane.
Conclusions: The humeral head surface is not spherical. Therefore, currently used shoulder prostheses do not perfectly restore the normal anatomy and biomechanics of the shoulder joint. Malpositioning of a prosthetic head could lead to an unsatisfactory result.

FM26

Fair to good correlation of goutallier rating of supraspinatus fatty changes on axial and parasagittal reformatted computed tomography images

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Purpose: To compare the assessment of fatty infiltration of the supraspinatus muscle on parasagittal views with the standard Goutallier grading on axial computertomographic images.
Methods: Three independent readers rated fatty changes of the supraspinatus muscle on CT scans of 91 shoulders. Goutallier grades were assessed on axial and parasagittal-reformatted CT images in two different reading sessions. Paired-t-test was used to find differences between grading results on axial and parasagittal-reformatted images. Pearson correlation coefficient (PCC) and weighted kappa statistics were employed to quantify linear correlation, intrareader and interreader agreement.
Results: Average Goutallier grading on axial images among all readers was 0.80 (range, 0–4; standard deviation 1.16) and 0.89 (range, 0–4; standard deviation 1.08) on parasagittal reconstructions. The was a trend to a slightly higher Goutallier grading on parasagittal reconstructions, however not significant (paired-t-test: $p = 0.07$). PCC was 0.702 ($p < 0.001$). Weighted kappa statistics indicated a moderate to good intrareader (range of weighted kappa 0.53–0.62) and interreader (weighted kappa: axial images 0.55; parasagittal-reformatted images 0.65) agreement.
Conclusion: Grading of fatty infiltration of the supraspinatus muscle on parasagittal CT images is comparable with the standard Goutallier grading on axial images and is characterized by a moderate to good intrareader and interreader agreement. Parasagittal assessment is characterized by a slightly higher interreader agreement and may therefore indeed be preferable.

FM27

The balloon, a new revolutionary technique for massive irreparable rotator cuff tears: Preliminary results at 1 year follow-up, after balloon degradation

Leslie Naggar

Introduction: Patients having massive irreparable rotator cuff tears with painful functional impairment represent a therapeutic challenge when conservative treatment has failed. The objective of this study is to introduce a new revolutionary mini-invasive technique for the treatment of massive irreparable rotator cuff tears, consisting of an inflatable "balloon" introduced arthroscopically in the subacromial space. The initial results of this new technique will be presented.
Methods: This is a prospective and on-going series of the first 35 balloons implanted. This report concerns the first 22 cases, counting 13 females and 8 males (1 case operated on both shoulders), with a mean age of 69.3 years (range 50–83), and a follow-up greater than 1 year (mean 24 months). The biodegradable balloon, consists of a copolymer of poly-L-lactide-co-epsilon-caprolactone membrane. The balloon will restore shoulder kinematics, by acting as a subacromial spacer and by repositioning the center of rotation of the humeral head. The surgical technique is arthroscopic. After having checked the non-reparability of the cuff, a minimal bursectomy is performed. An acromial roughening, but not a normal acromioplasty, is then done, taking care not to section the coracoacromial ligament. Before implantation, the size is measured, and the balloon is introduced folded, inside an insertion sheath, then it will be inflated with a saline solution. Mobilizing the humeral head then checks stability of the balloon. The balloon can also be used in partial cuff repairs. The long head of the biceps is also addressed through tenotomy or tenodesis.
Results: The results are good and excellent in 86% of the cases, with complete pain relief and a very rapid recovery (often after 6 weeks) of active and painless range of motion. The mean Constant score is improved and almost doubled postoperatively. The progress in power can continue up to 18 months postop, which is way beyond the period that is usually noted for balloon degradation (10 to 12 months maximum).
Conclusion: The ideal indication for the balloon is an irreparable massive rotator cuff tear, particularly in patients aged less then 70 years of age, in which a reverse shoulder prosthesis should not be implanted, as well as in older patients. The balloon implantation is ideal for massive irreparable rotator cuff tears, as it is a simple, low risk and less invasive operation than conventional techniques.

FM28

Correlation Between ASES and SANE Scores After Rotator Cuff and SLAP Repair

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Backround: Over 44 scores have been proposed to measure the shoulder function. Among the most popular are the American Shoulder and Elbow Surgeons (ASES) and Single Assessment Numeric Evaluation (SANE) scores. However, the ASES score contains overall 41 items based on objective and subjective measures and can hence be time-consuming compared to the SANE score, which only consists in one question. Simple subjective scores have become more popular in the last decades because they are easily administrated and accepted, timesaving and avoid the bias of inter-observer variability. A high degree of correlation between ASES and SANE score has already been found for shoulder instability, but nothing had yet been demonstrated for other shoulder pathologies.
Purpose: The purpose of this study was thus to compare the ASES and SANE scores after rotator cuff and superior labral tear from anterior to posterior (SLAP) repairs.
Methods: This study was a retrospective review of a prospective recorded database of patients operated arthroscopically by the same shoulder surgeon in a single institution. The patient database included prospectively recorded preoperative and outcome measures, notably ASES and SANE scores. Pearson coefficient was used to establish correlation between both scores. Those scores were compared in the three groups separately and altogether.
Results: 262 patients were included in our analysis. The mean age was 56.8 years old (+/– 13.6) with 177 male (68%). Three patients groups were identified: primary cuff repair (N = 135), SLAP repair (N = 54) and cuff revision (N = 73). The overall mean ASES score and SANE score after surgery were 82.7 (+/– 20.2) and 83.3 (+/-19.6) respectively. The Pearson's correlation coefficient (r) between both scores was 0.8, (p = <0.001) demonstrating a very good (high) correlation. In subgroup analysis, the correlation was highest in the cuff revision group (r = 0.88, p = <0.001), followed by the SLAP group (r = 0.78, p = <0.001) and primary cuff group (r = 0.75, p = <0.001).
Conclusion: SANE score is rapidly administered, simple, comprehensible and cost-effective compared to the ASES score. This study reports a high correlation between SANE and ASES scores in rotator cuff and SLAP repairs. We thus recommend the SANE score as a reliable outcome indicator for iterative follow-ups, which can be wisely combined with the ASES for preoperative and final assessment.

FM29

Secondary Latissimus Dorsi Transfer for Residual Dysfunction after Reverse Total Shoulder Arthroplasty

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Introduction: Reverse Total Shoulder Arthroplasty (RTSA) allows restoration of overhead elevation in patients with pseudoparalysis for elevation due to irreparable rotator cuff tear. However, loss of external rotation can often not sufficiently be addressed. RTSA and Latissimus dorsi Transfer (LDT) as a single stage procedure has been described for combined pseudoparalysis of elevation and external rotation. Secondary LDT in patients with functional loss of external rotation, which persisted or decreased after previous RTSA has not yet been studied. The aim of this retrospective study was to evaluate the clinical results of secondary LDT in such a patient group.
Methods: Between February 2006 and October 2010, ten patients were treated with LDT at a mean of 27(4–134) months after RTSA. In 6 patients the teres major was additionally transferred according to the technique of l'Episcopo. All patients had preoperative and postoperative clinical evaluation including a structured interview and the assessment of the Constant score (CS) and the Subjective Shoulder Value (SSV).
Results: With the RTSA the preoperative relative CS increased from 26% (11–67) to 51% (20–100) (p = 0.05). However, patients were dissatisfied mainly because of loss of active external rotation.
At a mean of 49 (23–67) months after LDT relative Constant score increased to 58% (34–100). This further increase did not reach statistical significance (p = 0.14) but remained significantly increased compared to pre RTSA (p = 0.021).
The SSV was 15% (0–30) before and 44% (20–70) after RTSA (p = 0.27) and 50% (0–90) after LDT (p = 0.92), which was a significant improvement compared to pre RTSA (p = 0.042).
Flexion increased from 36° (0°–130°) to 86° (10–140) after RTSA (p = 0.024) and further increased to 109° (70–140) after LDT (p = 0.017). Similarly abduction increased from 31° (0-85) to 80° (40–130) (p = 0.011) and 92° (50–130) (p = 0.039).
Active external rotation decreased from 0° (–80–50) to –18° (–50–10) after RTSA (p = 0.079) and was improved to 2° (–40–40) after LDT (p = 0.024).
Discussion and Conclusion: The clinical results for these patients are inferior to the results of single stage RTSA and LDT for combined pseudoparalysis of elevation and external rotation. Secondary LDT after RTSA improved active mobility significantly, CS and SSV were improved but not significantly.

FM30

Influence of fatty supraspinatus muscle degeneration on rehabilitation after arthroscopic rotator cuff repair: A prospective case series

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Introduction: Fatty muscle degeneration has been known to diminish function after rotator cuff reconstruction and contributes to failure of surgical repair. It, however, is yet unknown to what extent fatty degeneration influences speed of postoperative recovery. This prospective case series aims to identify how fatty supraspinatus degeneration (graded according to Goutallier) affects early rehabilitation after cuff repair.
Methods: 69 patients undergoing arthroscopic supraspinatus tendon double row suture anchor repair were followed prospectively for one year after surgery. Clinical analysis and scoring was acquired by an independent examiner unrelated to the performing surgeon. Quick-DASH and SPADI scores, as well as range of motion and abduction starting strength were measured preoperatively and at 3, 6 and 12 months after surgery. 8 patients were lost to follow-up due to incomplete independent clinical analysis. For the remaining 61 patients, radiographic analysis was performed by an MRI-experienced radiologist in order to determine fatty degeneration equivalents in preoperative arthro-MRI scans. Group 1 (Goutallier 0) included 31 patients (50.8%), group 2 (Goutallier 1) 21 (34.4%) and group 3 (Goutallier 2) 9 patients (14.8%). No patients with higher graded fatty degeneration had qualified for arthroscopic repair. T-Test and Spearman-correlation were used for statistical analysis, significancy was defined at p <.05.
Results: At 3 months, group 1 displayed significantly faster improvement in SPADI ($\Delta1$=–15.4 ± 19.9; $\Delta2$ = –1.2 ± 27.1; $\Delta3$ = –5.7 ± 13.1) and Quick-DASH ($\Delta1$ = –23.1 ± 23.7; $\Delta2$ = –11.5 ± 20.0; $\Delta3$ = –12.0 ± 16.1). The amount of improvement had leveled with groups 2 and 3 at 6 months after surgery. Range of motion displayed similar recovery profiles in all groups. Recovery of endpoint strength at 12 months was significantly better in group 1 ($\Delta1$= +3.2 kg ± 2.9; $\Delta2$ = +1.3 kg ± 2.2; $\Delta3$ = +1.8 kg ± 2.0) with no differences in terms of rehabilitation speed. Tendon retraction (Patte) and rupture size (Bateman) had no significant influence on the examined early rehabilitation parameters.
Conclusion: Patients with supraspinatus degeneration Goutallier grade 0 display quicker improvement in SPADI and Quick-DASH scores during the first 3 months. Faster short-term recovery after arthroscopic repair can be expected in this group. At 6 months, however, Goutallier 1 and 2 had caught up in terms of functional improvement. Goutallier 0 implies higher potential of restoring abduction strength postoperatively.

FM31

The ventral Latissimus dorsi transfer for irreparable subscapularis tears. A cadaveric study with anatomical aspects

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Background: Chronic, irreparable tears of the subscapularis tendon often result in weakness and disabling pain of the affected shoulder. If there is a combination with an irreparable superior rotator cuff tear, results of pectoralis major tendon transfers are poor and there are currently no treatment options except for total shoulder arthroplasty. We hypothesized that due to a potentially more favourable direction of pull, a ventral proximal transfer of the latissimus dorsi tendon insertion may be a new option to restore shoulder function in such patients. This anatomical cadaveric study was therefore designed to explore this new surgical option and the associated technical details and risks.
Methods: We performed a study of five human cadavers (three left and two right shoulders) fixed in Thiels solution. One shoulder was affected by a partial subscapularis tear with a consecutive medial subluxation of the long biceps tendon. Through a deltopectoral approach the pectoralis major tendon was released from its insertion at the humeral shaft. Following the exposition of the insertion of the latissimus dorsi tendon, measurements of anatomical references including the axillary nerve, the radial nerve and the musculocutaneus nerve were taken. The latissimus dorsi tendon was shifted proximally

along the posterior surface of the conjoined tendon and fixed with transosseus sutures to the minor tuberosity where the subcapularis had been previously released.
Results: In all five cadavers the mobilization of the latissimus dorsi tendon was performed without difficulty. The distance of the proximal insertion of the latissimus tendon was 28 mm (+/–5 mm) to the axillary nerve and 27 mm (+/–5 mm) to the radial nerve, which is crossing the latissimus dorsi muscle directly on its ventral surface and must be protected together with the musculocutaneous nerve by lifting the conjoined tendon ventrally using a retractor. The mean distance of transfer was 43.2 mm (+/– 7.66 mm).
Discussion: This new surgical technique could be reliably performed in the tested cadavers and appears to be reasonably safe concerning neurovascular structures. As hypothesized, the latissimus dorsi tendon can be transferred to the lesser tuberosity and does anatomically insert in a favourable angle, according to its line of action simultaneously performing both internal rotation and depression of the humeral head.

FM32

Neuropathy of the Suprascapular Nerve and Massive Rotator Cuff Tears. A prospective Electromyography Study

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Introduction: An association between massive rotator cuff tears (RCT) and suprascapular nerve neuropathy (SSNN) have been previously suggested. The anatomical course of the suprascapular nerve is relatively fixed along its passage. Injury to the nerve by trauma, compression and iatrogenic reasons is well documented. But as a reason for pain and weakness in massive RCT due to muscle retraction and nerve impingement remains unclear. We aimed to prospectively evaluate the suprascapular nerve for preoperative electromyography (EMG) abnormalities in shoulders with massive RCT.
Methods & Materials: A prospective study was performed in two centers. Fifty patients with retracted tears of both supra- and infraspinatus were evaluated. This was confirmed with preoperative computed tomography (CT) arthrograms, and the fatty infiltration of the affected muscles was graded. Forty-nine preoperative EMGs were performed in a standardized fashion and the results analyzed twice.
Results: Six of 49 (12%) shoulders had neurologic lesions noted on EMG; one SSNN, one radicular lesion of the C5 root, one affected EMG in the context of a previous stroke, three cases of partial axillary nerve palsy with a history of shoulder dislocation. No difference or diminution of the latency or amplitude of the EMG curve were found in the cases that presented significant fatty infiltration.
Conclusion: An EMG study did not detect a suprascapular lesion in the majority of cases of massive RCT. With a low association of neuropathy with massive RCT, there is no support for the routine suprascapular nerve release when performing a RCT repair.

FM33

Fluoroscopic, MRI and Electrophysiologic Assessment of Shoulders with Massive Tears of the Rotator Cuff

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Background: It remains unknown why some patients preserve their shoulder function despite a massive rotator cuff tear while others develop pseudoparalysis. The purpose of this study was therefore to analyse anatomical, biomechanical and/or electrophysiological factors possibly determining shoulder function in patients with massive cuff tear.
Methods: 19 patients (20 shoulders) with a painless, massive (>2 tendons) rotator cuff tear were prospectively assessed from the November 2011 until the December 2012 and divided into group PP (pseudoparalytic group with 9 shoulders and average flexion of 42 (range 20 to 85) degrees) and group NP (not pseudoparalytic with 11 shoulders and average flexion of 145 (range 130 to 165) degrees). All patients underwent an evaluation protocol including Constant score, shoulder MRI, fluoroscopic motion scan in ap and Neer projection while attempting shoulder elevation to evaluate the pattern of the glenohumeral and scapulothoracal motion and surface and needle electromyographic evaluation of the deltoid muscle to explore a possible muscular coordination problem on the three deltoid portions during shoulder elevation.
Results: The average Constant score reached 30 (range 11 to 47) points in group PP and 68 (range 55 to 87; p <0.001) in group NP. The mean Goutallier stages of SSP and ISP were 4 in both groups, of the SSC we found significant differences with a mean stage 3 in group PP and stage 1 in group NP. The anterior center-cuff angle, defined as how far the tear extends caudally towards the SSC, was significantly lower with a mean of –11 (range –31 to 9) degrees in group PP compared to 24 (range 0 to 47; p <0.001) degrees in group NP. Significant differences were seen in the fluoroscopy results regarding the Hamada classification, the acromiohumeral distance (ACHD) and the pattern of the glenohumeral and scapulothoracal movement. There were no axillary nerve lesions and no significant differences among the groups regarding the coordination of the three deltoid parts.
Conclusion: There seems to be a relevant association between pseudoparalysis and the cuff tear configuration when analyzing the anterior cuff angle. Interestingly however, the innervation pattern of the deltoid muscle appears normal also in case of pseudoparalysis. Our findings support the concept of a functional antero-posterior force couple, necessary to stabilize the humeral head to perform an elevation over 90 degrees.

Free communications III – Hand

FM34

Intraoperative fluoroscopy for ORIF of distal radius fractures

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Introduction: intraoperative fluoroscopy is the only readily available tool to assess quality of reduction and implant placement in operative fracture treatment. Although of key importance in the everyday practice of the orthopaedic surgeon, there are no commonly accepted guidelines in the use of intraoperative fluoroscopy in terms of application, incidences, anatomic landmarks, assessment of reduction and implant placement.
Method: we have compiled and analysed the recent literature and our own experience on radiologic assessment of distal radius fractures during operative treatment. We selected appropriated techniques for intraoperative use with fluoroscopy in order to assess 1) extraarticular reduction, 2) reduction of the radiocarpal joint, 3) the DRUJ, 4) dorsal screw penetration 5) articular screw penetration, and 6) correct implant placement. In anatomic specimens we marked the anatomic landmarks with lead in order to identify them under fluoroscopy. We then reproduced the described radiologic techniques to assess their feasibility in an intraoperative setting using fluoroscopy. Standard projections were also investigated in order to give guidelines for their correct use.
Results: we identified several additional radiologic views of the wrist joint that can be used intraoperatively using fluoroscopy. An algorithm was then developed with the correct use of standard projections and additional projections to intraoperatively assess reduction and implant placement in the operative treatment of distal radius fractures.
Conclusion: Intraoperative fluoroscopy of the wrist can be standardised during operative treatment of distal radius fractures in order to correctly assess reduction and implant placement and minimise surgical errors.

FM35

Does implantation of a denatured cellulose adhesion barrier improve finger function after P1 fracture ORIF

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Introduction: Postoperative extensor tendon adhesions after osteosynthesis of finger P1 fractures often lead to results with dissatisfactory functionality. The idea of an adhesion barrier has often been mentioned. Due to unconvincing results, however, they have not reached a level of acceptance among hand surgeons. This means that the problem of postoperative adhesions remains unresolved. It is the aim of our prospective randomised trial to evaluate the value of a product consisting of denaturised cellulose.

Methods: 38 of 42 projected patients have been included between February 2010 and February 2013, of whom 32 were conclusively evaluated. The trial included all isolated and closed P1 fractures which had an indication of plate osteosynthesis. The trial excluded patients with multiple injuries and those with pre-existing functional deficits. Pre-operative randomisation into two groups (with or without application of the adhesion barrier). Measurement after 6 weeks and 6 months after surgery of range of motion as an expression of functionality of the affected finger in comparison with the unaffected opposite side and measurement of DASH score. Recording of need for intraoperative tenolysis as part of the metal removal six months after osteosynthesis.
Results: After six weeks, the group which had been treated with an adhesion barrier showed a significantly better ROM and DASH score. After six months, both groups showed practically identical measurements. One patient refused further checks, two patients had to be excluded due to infection or excessive screw length.
Conclusion: The results after six weeks are interesting, as they indicate clearly better results for the group with adhesion barrier. It remains to be discussed why the results of both groups were practically identical after six months. The risk of infection where cellulosis matrix is used will have to be critically monitored. One infection has to date been detected in a patient with adhesion barrier. After analysis of the so far acquired data the use of such a device has at least to be questioned. Final results of the entire patient group will have to be obtained before conclusive recommendations to the standardised use of adhesion barriers can be made.

FM36

Treatment of highly comminuted distal radius fractures with temporary distraction plate: case reviews

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Introduction: Support of highly comminuted distal radius fractures in elderly patients with poor bone quality or in young polytrauma patients need a surgical technique in order to rebuild an anatomical alignment. The aim of the study was to show post-operative results in 10 patients with temporary bridge plate and complementary osteosynthesis.
Methods: A retrospective review was performed in 10 patients with comminuted distal radius type C3 by the AO classification that had temporary distraction plate in our service since 2011. All patients had pre and post-operative x-ray and a pre-operative CT-scan. We obtained a data base with radiological (radial length, pre and post-operative ulnar variance, radial inclination, time of consolidation), surgical (additive procedures on the radius or ulna apart from the distraction plate), and clinical information (age, professional activity, post-operative clinical examination).
Results: We treated 10 patients with mean age of 58 y (from 17y to 92 y). Half of patients were retired, we had one engineer, one nurse, one student and one unemployed. Apart from the fracture 2 patients had an acute carpal tunnel syndrome. Concerning ligament injuries we had one TFCC lesion, one DRUJ instability associated with ulnar styloide fracture, and 2 radio-triquetral lesions. All patients had one single dorsal incision from distal radius to the third metacarpal. We used locking compression plate 3.5 mm for the majority of the patients expect for 2 patients that had Buchler plate 2.4–3.5 mm. 3 screws were placed in the distal radius and 3 in the third metacarpal. All patients had a supplemental fixation to complete the radio-carpal reduction with: pins in the styloid in 8 patients, anterior VA plate in 2 patients, screws in 4 patients. 5 patients had bone graft on the radius. Only 2 patients needed an additive fixation of the ulna: one Darrach and one DRUJ stabilization with TFCC reinsertion. Moreover, 3 patients had carpal tunnel surgery. Concerning radiological results the mean pre-operative ulnar variance was + 1.4 mm, post-operative ulnar variance was + 0.69 mm, radial inclination was 18° and radial length was 9.7 mm. All patients had CT-scan before removal of osteosynthesis material in order to see distal radius articular surface and congruous position. 3 months after surgery 6 patients had removal of their material, one patient after 2 months. Mean post-operative range of motion was F/E: 38/0/68 and P/S: 43/0/58.
Conclusion: Temporary bridge plate is indicated in highly comminuted distal radius fractures in elderly patients with poor bone quality and young polytrauma patient. Indeed, the plate is acting like an external fixator but is internal closed to the bone maintaining radial length. Like this, during radius healing patients, without protection, can perform activities of daily life thanks to intrinsic stability. This is an advantage compared to the external fixator. This kind of fractures can be associated with ligament injuries. Visualization and repair of these injuries are permitted through one single dorsal incision. During closure, the extensor retinaculum is used to protect the tendons from the distraction plate. In our study we noticed we always had to add a surgical gesture on the radius with pin, screw or additive plate. However, all the materials were removed in the same time as the distraction plate. One disadvantage of this technique is that the plate needs to be removed during a second operation. We know that a second surgery in the population of older patient might be a risk factor that should be kept in mind and explained to the patient before the surgery.

FM37

Ligament origins are preserved in distal radial intraarticular two part fractures: A computed tomography based study

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Background: Operative fixation of displaced intraarticular distal radius fractures is increasingly common. A greater understanding of fracture patterns will aid surgical fixation strategy. Previous studies have suggested ligamentous insertions may less commonly be involved, but these have included heterogenous groups of fractures and have not addressed listers tubercle.
Hypothesis: Fracture lines of distal radial intraarticular two-part fractures (DRIF's) have reproducible fracture patterns. They propagate through the cortical bone between ligament origins and do not involve Lister's tubercle.
Methods: Axial CT scans of 2 part intraarticular distal radius fractures were assessed. The fractures were mapped onto a grid and the cortical breaches measured and expressed as a percentile of the total radial width or length. The cortical breaches were compared to the known ligamentous insertions on the distal radius of the long and short radiolunate, the radioscaphocapitate, dorsal radio carpal ligaments and listers tubercle. Associated injuries were also documented.
Results: The cortical breaches occurred between the ligamentous insertions in 85%. Listers tubercle was not involved in 95% of fractures. Three major fracture patterns emerged; radial styloid, dorsal and volar. Each major fracture had 2 subtypes. Associated injuries were common. Scapholunate dissocation was associated with all types, not just the radial styloid fracture pattern.
Conclusion: The fracture pattern of 2 part intraarticular fractures mostly involved the interligamentous zones. Three major groups were identified. Radial styloid Dorso-ulnar, and volar. Listers tubercle was preserved with fractures tending to pass radial or ulnar to this structure.

FM38

Infection and functional outcome of hip and knee Prosthetic Joint Infection – A retropsective multicenter study

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Introduction: Prosthetic joinc infections (PJI) lead to significant long-term morbidity with high costs of healthcare.
Objectives: We evaluated outcome of hip and knee PJI in two centers over a 14-year period.
Methods: Hospital charts of patients aged >18 years presenting with a hip or knee PJI from 1995 to 2008 were reviewed, stratified according to wether a treatment algorithm (zimmerli W. NEJM 2004) was followed. Good outcome was defined as functional prosthesis in place and significant reduction of pain allowing return to normal daily activities.
Results: We included 272 episodes, 193 hip and 79 knee PJI (median age 72 years, range 19–102 years, 53% males) with a median follow-up of 3.4 years(range 0.1–4.2 years). PJI were treated with (i) debridement & retention without change of mobile parts in 30 cases (11%), (ii) debridement & retention with change of mobile parts in 99 cases (36%), (iii) 1-stage exchange in 21 cases (7%), (iv) 2-stage exchange in 100 cases (37%), and (v) definitive prosthesis removal in 18 cases (6%). 170 patients (63%) were treated according the algorithm. The infection outcome was overall favorable in 82% and differs according to surgical treatment: 40% for debridement without change of mobile parts, 81% for debridement with change of mobile parts, 76% for 1-stage exchange and 92% for 2-stage exchange. Microbiological cure was reached in all patients, but in 34 cases by definitive prosthesis removal. Final functional outcome was significantly better when treated according to the algorithm (76% vs 24%, p <0.0001). The best functional outcome was achieved with debridement & retention with change of mobile parts (93%), compared to 70% for debridement & retention without change of mobile parts, 80% for 1-stage exchange, and 70% for 2-stage exchange.
Conclusion: Debridement & retention without change of mobile parts is often associated with failure. Debridement & retention with change of mobile parts have excellents results. Eradication of infection was associated with a good functional outcome in 76% if the algorithm was followed, compared to 24% when it was not.

FM39

Does spacer usage in prosthetic joint infections influence infect resolution?

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Background: Since two-stage exchange is the most common strategy treating prosthetic joint infections the use of spacers during the interval before reimplantation remains discussed controversially. We investigated the influence of antibiotically loaded cement spacers on prosthetic joint infect resolution in total knee and hip replacement.
Methods: 120 consecutive patients with confirmed infection of total hip arthroplasties [THA] or total knee arthroplasties [TKA] were treated with a two-stage exchange concept. Patients were retrospectively allocated in two groups: patients with and patients without spacer implantation. Our hypotheses were primarily, that spacer implantation improves the overall success rate regarding infect resolution and secondary, that spacer implantation reduces the success rate in patients with bacteria graded as “difficult to treat”.
Results: Patients with and without spacer implantation did not vary significantly in age, sex, weight, height, and body mass index (BMI). A backward-stepwise multivariate logistic regression model neither showed an association between spacer use and definitive infect resolution with an adjusted odds ratio of 1.2 (95% CI 0.4 to 3.2) at a p-value of 0.756 nor between spacer use and clinical infect resolution with and adjusted odds ratio of 4.0 (95% CI 1.0 to 17.0) at a p-value of 0.056. Again spacer use and “laboratory infect resolution” with an adjusted OR of 4.3 (95% CI 0.7 to 27.9) at a p-value of 0.127 did not show a significant correlation. Additionally we were not able to show any adjusted significant association between infectious organisms graded as “difficult to treat” and spacer use effectiveness.
Conclusion: Our data does not support the use of spacers regarding infect resolution in prosthetic joint infections treated in a two-stage exchange. Infectious organisms “difficult to treat” did not show a significant association with infect resolution and spacer use either.

FM40

Increased risk of infection in MIS total hip arthroplasty with an anterior approach?

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Introduction: MIS hip replacement has an increasing popularity but there is a lack of data concerning probable complications. The minimally invasive direct anterior approach (Smith Peterson, MIS) was introduced as routine procedure at our hospital. Patients were followed in a prospective cohort study and we observed problems in wound healing. The purpose of this work is 1) to evaluate the prevalence of infection and 2) to identify patient-related risk-factors for infection.
Methods: 601 consecutive hips in 551 patients (286 males, mean age 70 years) undergoing MIS primary hip replacement since 03/2009 have been included, no patient was lost to follow-up. Standardized clinical and radiological data were collected. Infection was diagnosed in case of presence of symptoms, delayed wound exudation, a fistula, at least two positive microbiological samples or positive histology.
Results: There were 12 cases of infection (2.0 %). Coagulase-negative staphylococci were the most frequent pathogens (9/12, 75%). In 58% of cases, polymicrobial infections were present. Among them, pathogens that can be attributed to fecal flora (enterococci, enterobacteriaceae, anaerobes) were found in 42%. Ten infections occurred within ninety days after operation, the median time to the diagnosis of infection was 13 days (range, 10 to 416 days). All infected hips were re-operated. In nine cases, an early debridement was performed and three cases got an exchange of the implants (2 two-stage revisions and 1 one-stage revision).
A higher BMI (mean BMI 33.6 vs 26.9, p <0.001) and a higher ASA Score (p <0.001) were found for the infected Group. Gender, age, diagnosis, elective/nonelective or transfusion/no transfusion showed no differences.
Conclusions: The infection rate for the studied MIS cohort was rather high (2.0%) compared to published data in conventional hip replacement (0.5 to 1.0 %). The high proportion of polymicrobial infection and fecal pathogens points to a critical role of the skin flora in the groin and near the incision site. A more lateral incision leading away from the groin might be preferable, especially in obese patients. But further data are necessary to ensure that infection is not the major disadvantage of the MIS anterior hip replacement.

FM41

Performance and cost evaluation of Gram and Acridine staining for prediction of septic arthritis stratified among different patient populations

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Background: Gram staining has a low sensibility in the diagnosis of native joint septic arthritis. Little is known about the accuracy of other staining techniques or among patients with arthroplasty infections, ongoing antibiotic medication, immune suppression, gout or other crystal arthropathies.
Methods: Cohort study with cost evaluations at the Orthopedic Service of Geneva University Hospitals January 1996-October 2012.
Results: Among 500 arthritis episodes (196 with immune suppression; 227 with underlying arthroplasties; 69 with gout or other crystals in microscopic synovial count), Gram staining revealed pathogens in 146 episodes (146/500, 29%) or in 146 of 400 culture-positive episodes (37%), while acridine staining yielded pathogens in 100 of 400 culture-positive episodes (25%). Correlation between the Gram and acridine staining of the same examination was good (Spearman 0.85). Overall, the sensitivity, specificity, positive and negative predictive values for the predilection of culture-positive arthritis was 0.37, 0.99, 0.99, and 0.28, respectively. Sensibility values were similar for substrata of the study population. It was 0.33 for arthroplasty infections, 0.40 in immune suppressed patients, 0.36 in patients under antibiotic administration and 0.52 with concomitant synovial crystals. For culture-negative cases, the Gram and the acridine staining caused 45% of all laboratory costs, for culture-positive cases both stainings made 25% of the expenditures.
Conclusion: The sensitivity of Gram or acridine staining for the predilection of culture-positive arthritis is low, independently of underlying material, immune suppression, or antibiotic therapy. The sensitivity in presence of synovial fluid crystals is moderate. Acridine orange reveals the same performance as Gram staining. Considering the costs, both staining cannot be supported as necessary diagnostic tool for septic arthritis.

FM42

Are infantile non tuberculous spondylodiscitis mostly due to Kingella kingae? A prospective study

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Study design: Prospective study to gather clinical, paraclinical, and radiographic data of spondylodiscitis of children aged between 6 and 48 months, and to test a new bacteriological diagnosis' approach.
Objectives: To analyze and assess the clinical, laboratory, and radiologic findings in children aged between 6 and 48 months, and to document the efficacity of a new approach of bacteriological diagnosis based on K. kingae-specific real-time polymerase chain reaction (rtPCR) assays from peripheral blood and throat swabs.
Background Data: Infantile form of spondylodiscitis is a rare entity that often presents a mild-to-moderate non-specific clinical picture. Laboratory studies generally demonstrate an increased ESR, whereas WBC count and CRP can be normal or slightly elevated. Blood cultures are usually negative, and identification of the causative can be difficult even on disk or vertebral aspiration. Assessment of the clinical manifestations, and of the biologic microbiologic characteristics is essential for prognosis and for justification of the nonoperative treatment.
Methods: Ten children (4 girls and 6 boys) with a mean age of 24 months (range: 13 to 39 months) were hospitalized for spondylodiscitis between January 2009 and December 2012. Parameters related to the duration of symptoms, clinical manifestations, diagnostic workup, and course of the treatment were prospectively collected.
Results: All the children presented with uncharacteristic signs and symptoms. The laboratory markers of inflammation were only moderately elevated. The diagnosis of spondylodiscitis was established in average after a delay of 29 days (range: 3 to 62 days). Blood cultures taken as initial investigations were all negative. K. kingae-specific rtPCR assays were positive in peripheral blood in two cases, whereas the test was always positive on throat swabs.
Conclusions: Our study shows that the course of spondylodiscitis in children aged between 6 and 48 months is characterized by a mild-to-moderate clinical and biologic inflammatory response. It suggests also that detecting K kingae DNA in the oropharynx provided strong enough evidence that this microorganism is responsible for the spondylodiscitis. Early bacteriological diagnosis can thus prevent unnecessary testing and invasive intervention.

FM43

Is there a place for conservative treatment of osteomyelitis of the hallux sesamoids? A monocentric case series study

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Introduction: Osteomyelitis of the hallucal sesamoids in young and healthy patients is a rare entity, and may originate from a hematogenous spread. But in diabetic patients with peripheral neuropathy it often results from direct contiguous seeding from adjacent ulceration. In our institution, all patients are treated conservatively, before eventually requiring a surgical procedure. We present a monocentric case series, in order to determine the effectiveness of a conservative therapy for osteomyelitis of hallucal sesamoids. To our knowledge, no such study has been conducted yet.
Material & Method: We reviewed 18 patients (4 women and 14 males) / 18 feet with a clinical and radiological diagnosis of osteomyelitis of the hallucal sesamoids treated in our institution during a 13 year period (2000–2012). The inclusion criteria were a signal alteration on MRI, CT or conventional radiography, combined with a deep ulcer. Conservative therapy consists in frequent wound treatment, immobilisation in a cast or other device, and empirical oral antibiotics.
Results: Among the 18 patients, 11 were diabetic, 14 had a peripheral neuropathy, 10 had a peripheral arterial disease and 5 were immunosuppressed. After a period ranging from 4 weeks to several month of conservative therapy, 83% (15/18) patients/feet required surgical debridement, excision, internal resection or amputation.
Conclusion: Most of the patients in the present study (14/18) are either diabetic, vascular or have a peripheral neuropathy. In this population, conservative therapy does not seem to be a valuable option. Patients should be advised, before starting a conservative therapy, that treatment takes long and is demanding, and very often ends with a surgical procedure.

FM44

Surgical Treatment of Calcaneal Osteomyelitis in the Diabetic Patient

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Introduction: Calcaneal osteomyelitis (CO) is a common complication of diabetic foot ulcers. Below-knee amputation is often the treatment of choice; however it is associated with loss of integrity and need for prosthetic fitting. Total and subtotal calcanectomies are considered to be an alternative to amputation. Purpose of the present study was to compare these three techniques in diabetic patients with regard to complications and the need for revision surgery.
Methods: Nineteen diabetic patients (mean age 61 ± 11 years; female 8, male 11) (19 feet) were enrolled and analyzed retrospectively after they underwent surgical treatment for CO between 01/2002 and 09/2012. Nine patients underwent subtotal calcanectomy, two total calcanectomy, and eight below-knee amputation. Demographic and clinical characteristics at time of diagnosis, complications during follow up and need for revision surgery were documented.
Results: Mean follow-up after initial diagnosis was 76 ± 36 months (range 3–140 months). Sensory neuropathy was present in all 19 patients (100%), additional peripheral vascular disease in twelve (63%) and nicotine abuse in eight (42%). Most isolated pathogenic microorganisms were coagulase-negative Staphylococci, followed by Staph. aureus and E. coli. Patients who initially underwent subtotal calcanectomy required secondary below-knee amputation in two cases (22%) and secondary total calcanectomy in one case (11%). One patient with primary total calcanectomy needed secondary below-knee amputation (50%). In one patient with primary below-knee amputation, secondary knee exarticulation was necessary (13%). Four out of five patients (80%) with revision surgery had additional peripheral vascular disease, one out of five (20%) nicotine abuse. Four patients died during follow up due to reasons not directly related to the interventions.
Conclusions: (Sub)total calcanectomy in diabetic patients with calcaneal osteomyelitis is associated with a high rate of secondary below-knee amputations. In patients with additional risk factors as peripheral vascular disease it can therefore not be recommended as an alternative to below-knee amputation.

Free communications IV – Spine

FM45

Short anterior correction of double major adolescent idiopathic scoliosis compared to standard posterior technique

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Introduction: Short anterior correction is an accepted method of treatment for single thoracic curves as well as for single thoracolumbar and lumbar curves in adolescent scoliosis (AIS). For double major curves the standard technique is fusion of both curves from posterior. The purpose of this study was to compare the novel technique of anterior short correction of double major curves to standard posterior pedicle screw instrumentation.
Methods: 19 consecutive patients with a double major AIS were treated surgically either by standard posterior pedicle screw instrumentation (n = 11) or by anterior short instrumentation (n = 8). All patients were followed at least 2 years (mean 5.6 ± 3 years, range: 2 to 10 years) clinically, radiographically and with pulmonary function tests. Patients` satisfaction was assessed with SRS-24 questionnaire.
Results: The curves were similar, the upper curves being 54 ± 7° and 59 ± 13°, lower curves being 63 ± 15° and 55 ± 9° in the anterior and posterior group, respectively. The upper curve correction was 77% in the posterior group and 52% in the anterior group. The lower curve correction was 79% in the posterior group and 56% in the anterior group. The amount of fused vertebrae was 7.6 ± 0.7 in the anterior and 12 ± 1 in the posterior group. The preoperative pulmonary function (%FVC) of 70–79% remained unchanged to the last follow-up in both groups. Patients` satisfaction assessed by SRS-24 questionnaire was high in both groups without statistical difference (SRS score range 98-101 at the last follow up).
Conclusion: Significantly less motion segments were fused to achieve a satisfactory correction through anterior instrumentation in double major curves of AIS. Pulmonary function and patients' satisfaction were comparable in anterior and posterior techniques.

FM46

Incidence and Risk Factors for Early Adjacent Vertebral Fractures after Balloon Kyphoplasty for Osteoporotic Fractures – Analysis of the SWISSspine Registry

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Purpose: The SWISSspine registry was launched in 2005 to assess the safety and effectiveness of balloon kyphoplasty (BKP). In the meantime, repeated reports on high rates of adjacent vertebral fractures (ASF) after BKP of vertebral insufficiency fractures were published. The causes for ASF and their risk factors are still under debate. The purpose of this study was to report the incidence and potential risk factors of ASF within the SWISSspine registry dataset.
Methods: The SWISSspine data points are collected perioperatively and during follow-ups, with surgeon- and patient-based information. All patients documented with a monosegmental osteoporotic vertebral insufficiency fracture between March 2005 and May 2012 were included in the study. The incidence of ASF, potential predictors (patient age, gender, fracture location, cement volume, pre- and postoperative segmental kyphosis) and influence on quality of life (EQ-5D) and back pain (VAS) were analysed.
Results: A total of 375 patients with a mean follow-up of 3.6 months were included. ASF was found in 9.9% (n = 37) and occurred on average 2.8 months after surgery. Preoperative segmental kyphosis >30° was found to be a significant predictor for ASF (p = 0.023). Further on, patients with ASF had significantly higher back pain at the final follow-up. No further predictors for ASF were revealed in the adjusted analysis.
Conclusions: The findings suggest that patients with a preoperative segmental kyphosis >30° are at high risk of ASF within three months after the index surgery. In case of an ASF event, back pain levels are significantly increased.

FM47

Reduction of cement leakage by sequential PMMA application

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Introduction: Cement leakage is the most common complication of percutaneous cement augmentation of the spine (vertebroplasty/ kyphoplasty) which, if present, can cause severe complications like pulmonary embolism. The viscosity of the polymethlymethacrylate (PMMA) cement is one main factor of the aetiology of cement leakages. Different application techniques can influence the viscosity of the PMMA cement using the temperature gradient between body and room temperature. The aim of this study was to evaluate different augmentation techniques ("all-in-one", "2-step","sequential") concerning their ability to avoid cement leakage and concerning optimal cement distribution in a standardized leakage model.
Material and Methods: For this study standardized vertebral body models with a preformed leakage-path, simulating a ventral vein, were used. 3 different injection techniques of 6ml PMMA were defined: "all-in-one" (application of 6ml PMMA in one single step), "2-step" (application of 1ml PMMA within 30s, 1 Min of holding time, application of 5ml PMMA), and sequential (sequential application of 0,5 ml PMMA, 1 Min holding time between the application steps). The application was performed via an 8 Gauche standard vertebroplasty needle in a 37,5 °C water bath at a room temperature of 19 °C. Standard PMMA vertebroplasty cement was used (Vertecem+, Synthes, Bettlach, Switzerland). The application was started 4 Min after the mixing process as suggested by the company. The leakage was assessed using a zonal graduation of the applicated cement in a standard x-ray (1:intraspongious (= no leakage), 2: extraspongious/ intracortical (= small leakage), 3: extracortical (= great leakage)). There were two leakage-paths estimated per vertebral body.
Results: There were 10 vertebral body models used per groups. Leakage was significantly reduced in the "sequential" group (2/20 leakages) compared both other groups ("All-in one" 20/20 leakages , "2-step": 15/20 leakages) (Chi-Squre 36,5; P <0,0001). Compared to the "sequential" group the risk of leakage (Odds Ratio) was 171-times higher in the "All-in-one"-group, and 27-times higher in the "2-step" group.
Discussion: The sequential cement augmentation is a safe method to avoid leakage in the vertebral body model. Using the temperature gradient between body and room temperature accelerates the polymerization progress of the PMMA cement in the vertebral body. By using sequential application of small cement amounts possible leakage paths were blocked before reapplication of the low-viscous cement. In how far these results are reproducible in clinics is topic of ungoing studies.

FM48

Prophylactic adjacent segment vertebroplasty during kyphoplasty in single segment osteoporotic vertebral fractures – A radiographic analysis

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Introduction: Percutaneous kyphoplasty (PK) is an option to treat painful osteoporotic compression fractures. The most frequently observed complications are adjacent segment fractures (ASF). Little information exists about the benefit of prophylactic cement augmentation of the adjacent vertebrae. Thus, it was the aim of this study to investigate the benefit of prophylactic vertebroplasty (PV) in single segment osteoporotic vertebral fractures treated with PK.
Methods: From January 2007 to August 2012, all consecutive patients treated with PK for painful osteoporotic single segment compression fractures were included for this retrospective study. Patients were treated, according to surgeon's preference, with PK alone or with additional PV of the adjacent segment(s). General data of all included patients (gender, age, hospital stay, fracture level, complications) was taken from medical records and operation protocols. The radiographic assessment consisted of plain lateral radiographs preoperatively, immediately postoperatively, at 3 months and at final follow-up. The fractures were classified analog to the AOSpine classification system and the segmental kyphosis angle was measured on each radiograph. The occurrence of new vertebral fractures was assessed for patients with and without PV.
Results: A total of 60 patients met the inclusion criteria. 2 patients died and 7 patients had incomplete follow up. 52 (87%) patients (45 females) with a mean age of 73.5 years (rage Y-Y) and a mean total follow-up of 401 days (range) were included for the analysis. In most of the patients (71%) the fracture was between Th10 and L2. 23 patients were treated with PV and 29 with PK only. The two groups did not differ significantly concerning age, gender, hospital stay, fracture location, segmental kyphosis, follow-up and complications.
Comparing the two groups: a fracture thourgh the primary treated vertebra (kyphoplasty) was found in 5 (22%) of the PV and in 3 (10%) of the PK group (p = 0.1). An ASF was found in 43% (10 pat.) of the PV and in 21% (6 pat.) of the PK group (p = 0.07). Remote fractures occurred in 1 (4%) patient of the PV and in 4 (14%) patients in the PK group (p = 0.7).
Conclusion: Prophylactic vertebroplasty of adjacent vertebra could not lower the risk of ASF in patients with single segment osteoporotic vertebral fractures. Therefore it's benefit is questionable considering possible complications and higher costs.

FM49

The patient's perspective on the outcome of surgery for lumbar degenerative scoliosis

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Introduction: The treatment of degenerative lumbar scoliosis (DLS) represents an increasing challenge, with the demand for surgery rising but the indications for appropriate treatment remaining controversial. Most studies to date have only examined outcome from the clinical and radiological perspective; few have evaluated patient-orientated outcomes. We examined patient outcomes in a consecutive series of patients being treated for DLS by simple decompression, limited fusion, or full correction with longer constructs.
Material and Methods: Our local spine surgery database (part of the Eurospine Spine Tango Registry) was used to acquire the data from patients with DLS as the main pathology undergoing first-time surgery at least 12 mo ago, using decompression (D) and/or fusion (F) as the operative procedure. Pre-operatively and at 12 mo follow-up (FU), patients completed the multidimensional Core Outcome Measures Index (COMI; 0-10); at 12 mo FU, global outcome was rated on a Likert-scale and dichotomised as "good" and "poor".
Results: 175 patients took part (121 (69%) women, 54 (31%) men). 83/175 (47%) patients underwent D alone at 1 to 5 levels (mean ± SD, 2.2 ± 0.8 levels), while 92/175 (53%) patients underwent F of 1 to 7 levels (2.6 ± 1.5), 79% with D and 21% without. 53 patients had short F (1–2 segments) and 39 had long F (≥3 segments). The D group was significantly (p <0.0001) older (76 ± 7y) than the F group (66 ± 11 y) and had higher comorbidity (p = 0.0001). All groups benefited significantly from surgery without significant difference between them: improvement in COMI was 3.2 ± 2.9 for D, 3.5 ± 3.1 for short F and 3.2 ± 3.2 for long F (p = 0.84); good global outcome was 68% for D, 79% for short F and 78% for long F (p = 0.39). Patient-rated complications were not significantly different between the groups (p = 0.99).
Discussion: Despite the high complexity of the disease, patient-orientated outcomes were similar to those reported using the same instruments in conditions such as lumbar stenosis and degenerative

spondylolisthesis. There was a tendency for better results in the short fusion patients; this should be further investigated in larger groups. In conclusion, both decompression and fusion for DLS yielded similarly good results from the patient's perspective. This most likely reflects careful and appropriate patient selection. Further analyses are warranted to identify baseline variables predicting the 20–30% cases with poor outcome.

FM50

Relationship between sedimentation sign and morphological grade in symptomatic lumbar spinal stenosis

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Introduction: There is no consensus on the radiological classification of lumbar spinal stenosis (LSS). Dural sac cross sectional area has been the main radiological measurement used in clinical practice but it does not always correspond to the degree of entrapment of the neural structures. The morphological grading of stenosis based on the rootlet/ cerebrospinal fluid relationship as seen on axial MRI images and comprised of 4 grades (A to D) has been shown by its proponents to carry a prognostic value with C and D grades being strong predictors of failure of conservative measures. Simultaneously another research team described the sedimentation sign, measured also on axial MRI images but at the level of the pedicle adjacent to the maximal stenosis level with a view to discriminate patients with neurological claudication from asymptomatic subjects. The aim of the present study was to find the relationship between those two radiological descriptions.
Material and methods: A total of 137 patients divided in three groups were included in this study. The first two groups comprised 110 patients with symptomatic LSS of whom 69 were treated surgically and 41 conservatively. A control group of 27 subjects with low back pain and no claudication (LBP) constituted the third group. We examined MRI images using Osirix software and studied the morphological grade of stenosis at disc level and looked for evidence of positive sedimentation sign, the latter being measured above or below the level of maximal stenosis, at pedicle level.
Results: No patient with grade A morphology had a positive sedimentation sign, while it was present in 58% of those with grade B stenosis. In patients with grade C and D stenosis the sedimentation sign was positive in 69% and 76% of cases respectively.
The sedimentation sign was positive in 66% (46/69) of the surgically treated patients, in 39% (16/41) of the conservatively treated patients and only in 8% (2/25) of the LBP patients.
Comparing patients with symptomatic LSS (both surgically and conservatively treated) and LBP subjects, we found that the presence of a sedimentation sign in the LSS group has a sensitivity of 56%, a specificity of 93%, a positive predictive value 97% and a negative predictive value of 34%. The presence of a positive sedimentation sign carried an odds ratio (OR) of 16 between those two groups.
In the group of patients with LSS who were either treated surgically or conservatively the presence of a sedimentation sign in the surgical group carried a sensitivity of 66%, a specificity of 60%, a positive predictive value 74% and a negative predictive value of 52%. The positive sedimentation sign carried an OR of 3.13 between the two LSS groups.
We found the presence of C or D morphological grades in 97% (67/69) of the surgical group, in 41% (17/41) of the conservative group and in18% (5/27) of the LBP group. The presence of a C or D grade was a strong predictor of surgical treatment in the LSS group with an OR of 47 (P <0.001).
Discussion: In this cohort of patients we found that the presence of a C or D stenosis grade was a stronger predictor of failure of conservative treatment than the presence of a positive sedimentation sign. Even though the sedimentation sign might be useful in identifying patients belonging to a claudicating or non-claudicating population, it might be less useful in deciding which patient needs surgical treatment. Additionally, since it is measured at pedicle level it is probably not suited in deciding which levels need to be surgically decompressed.

FM51

ALIF L5/S1 with stand-alone-cages: long term follow up

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Introduction: Anterior lumbar interbody fusion (ALIF) is associated with low approach-dependent morbidity and shows good mid-term results (1). Few long-term results have been published, especially for stand-alone cages.
Material/Methods: In a retrospective study, all patients who had undergone monosegmental ALIF L5/S1 from 2003–2008 were clinically and radiologically re-assessed. Two different cages with and without fixed angle (SynFix (SF)/ Syncage (SC) both Synthes, Switzerland) fixation were used as stand-alone implants. Radiological analysis concerning bony fusion and adjacent segment degeneration (ASD) was assessed using standard radiographs including functional x-rays. For clinical outcome assessment standard questionnaires of the Spine Tango data bank (ODI, SF-12, EQ-5D, COMI) and a questionnaire based on Grob et al (2) was used.
Results: 54 patients could be included in the study (mean age 49.3 years ± 11.1, range 25 – 84, male: 28, female: 26). Mean follow-up-time was 55.87 months (±18, range 28 – 102). Signs of stable bony fusion was observed in 92.3% (48/52) of the patients. In the functional x-rays 95.9% (47/49) were judged as stable. Radiological signs of ASD, in terms of decreasing disc height, was found in 17% (8/47). The revision rate during the FU period was 12.5% (7/54) (3x pseudarthrosis L5/S1, 1x persisting remaining disc protrusion L5/S1,1 x unclear persisting radicular pain without radiological correlation). Symptomatic ASD caused re-intervention in 2 cases. Compared to pre-operative, at final follow-up back pain improved in 89%, leg pain in 93% of patients. 82% stated global subjective improvement. 93% would undergo the surgery again. In some sub-items (SF-12: body pain; COMI: postoperative leg pain (Wilcoxon = 0.020), Grob: quality of life (Fisher = 0,023) + work ability (Fisher = 0,009)) the outcome in the SF group was significantly better compared tot he SC group. There was no correlation between radiological and clinical outcome.
Discussion: Stand-alone monosegmental ALIF L5/S1 shows favorable long-term results. Fusion rate is high. The rate of re-operations, especially caused by symptomatic ASD, is low. No correlation between radiological fusion and clinical outcome could be shown. Results are good concerning postoperative development of pain, quality of life and work status. Even though a tendency towards better results SF group could be show, due to the small sample number in the subgroups these findings should be interpreted carefully. The relevance of fixed-angel fixation of stand alone cages for the long-term outcome, as discussed before studies(1), should be evaluated in larger cohort studies.

1 Strube P, Hoff E, Hartwig T, et al. Stand-alone Anterior Versus Anteroposterior Lumbar Interbody Single-level Fusion After a Mean Follow-up of 41 Months. J Spinal Disord Tech. 2011.
2 Grob D, Benini A, Junge A, et al. Clinical experience with the Dynesys semirigid fixation system for the lumbar spine: surgical and patient-oriented outcome in 50 cases after an average of 2 years. Spine. 2005.

FM52

Spinal fusion versus non-operative treatment in patients with chronic low back pain: An avaerage 11-year follow-up of three randomized controlled trials

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Introduction: Chronic LBP (cLBP) is a complex and poorly understood problem and its management represents a major challenge to our healthcare systems. The relative efficacy of surgery over non-operative care for the treatment of cLBP remains controversial, and little is known of the long-term outcomes. This study compared the clinical outcome at long-term follow-up (LTFU) (average 11.4 (range 8–15) years) of patients who were randomized to either spinal fusion or non-operative treatment in three multicentre randomized controlled trials.
Methods: Participants were 473 patients with cLBP of at least 1 year's duration who were all considered candidates for spinal fusion. Treatment comprised lumbar spine fusion (instrumented or non-instrumented) or non-operative treatment (multidisciplinary cognitive-behavioral and exercise rehabilitation program). The primary outcome was the Oswestry Disability Index (ODIv2.1) score measured at LTFU. Secondary outcomes included VAS pain scales, pain frequency, pain medication use, work status, quality of life (EQ-5D), satisfaction with care, and global treatment outcome.
Results: 140/242 patients randomized to receive surgery and 121/231 randomized to receive non-operative care were available for LTFU. The intention-to-treat analysis showed no statistically or clinically significant differences between treatment groups for ODI scores at LTFU (adjusted for age, sex, smoking habit, previous surgery, duration of LBP and baseline ODI): the mean adjusted treatment effect of fusion was –1.4 points on the 0–100 ODI scale (95% confidence interval, –6.2 to 3.4). An as-treated analysis similarly demonstrated no advantage of surgery (treatment effect, –0.6 points on the ODI (95% CI, –5.8 to 4.5). There were no significant group differences for any of the adjusted values for the secondary outcomes.
Discussion: After an average of 11 years follow-up, there was no difference in patient self-rated outcomes between fusion and non-operative treatment for cLBP. The results suggest that, given the increased risks of surgery and the lack of deterioration in non-operative outcomes over time, the use of lumbar fusion in cLBP patients should not be favored in healthcare systems where combined physical and psychological programs are available.

FM53

What score on the oswestry disability index indicates a satisfactory symptom state?

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Introduction: The achievement of a given change-score, e.g. a 15-point reduction on a 0–100-scaled instrument, is often used to indicate clinically-relevant change after spine surgery. However, the achievement of such a change 1) depends on the initial preoperative score and 2) does not indicate whether a satisfactory symptom state is ultimately reached. The achievement of an absolute score equivalent to a satisfactory symptom state may be a more stringent measure of success; we quantified this score for the Oswestry Disability Index (v2.1).
Methods: 532 patients undergoing lumbar spine surgery completed the ODI and the Core Measures Outcome Index (COMI) at various times up to 4y after surgery. The COMI item: "if you had to spend the rest of your life with the symptoms you have right now, how would feel about it?" was responded to on a 5-point Likert scale from "very satisfied" to "very dissatisfied". Two receiver operating characteristics (ROC) analyses were used to derive cut-off scores for ODI that best predicted being 1) at least "satisfied" and 2) "very satisfied" with the symptom state.
Results: 114/532 (21%) patients were "≥satisfied" and 43 (8%) "very satisfied" with their symptom state. The ROC area under the curve was 0.89 (95% CI, 0.86–0.92) for "≥satisfied" and 0.94 (95% CI, 0.92–0.96) for "very satisfied" indicating the ODI discriminated well. The ODI-score cut-off predicting a "≥satisfied state" was ≤29 points (sens, 88% and spec 75%) and a "very satisfied state", ≤14 points (sens, 86% and spec 89%).
Discussion: Whilst change scores show the achievement of improvement after surgery, they may give a more optimistic view than when the proportion of patients achieving a satisfactory state is examined. In the absence of valid "norm values" for condition-specific questionnaires, the % patients reaching an ODI score equivalent to a satisfactory/very satisfactory state might represent a more appropriate criterion when assessing the success of surgery.

FM54

Perforations and Bacterial Contamination of Microscope Covers after Spine Surgery

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Background: Recent studies pointed out the possible role of bacterial shedding by surgical microscopes. The aim of this study was to determine the integrity of microscope covers after spinal surgery and to assess a possible correlation with the amount of bacterial contamination.
Methods: A prospective study of 25 consecutive spinal interventions with the use of a surgical microscope was performed. To assess for potential perforations of the microscope covers, these were filled with water after surgery and the presence of water leakage in three zones (objective, ocular, control panel) was documented. Microbiological smears were taken from each of the covers at the same locations before and after surgery. To determine our institution's wound infection rate after decompressive spinal surgery with use of a microscope, we retrospectively identified 265 patients that had underwent these interventions during the two years preceding the aforementioned investigation.
Results: One small perforation in 1/25 covers was observed which did not lead to bacterial contamination; 3/75 smears from 25 covers showed postoperative bacterial contamination, two in the ocular zone and one in the optical zone, without proof of a cover perforation. The infection rate in our clinical series of 265 patients was 1.1%.
Conclusions: Both, the rate and quantity of contamination and especially the occurrence of cover perforation were rather low. Infections after decompressive spinal surgery with use of a microscope were rare. Thus, the use of a surgical microscope with a foil cover is associated with an acceptable risk of infection.

FM55

The lumbar Spines of Professional Beach Volleyball Players – High Incidence of Spondylolysis

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Background: Beach volleyball is an Olympic overhead sport since 1996. Many professional players suffer from low back pain. It is not much known which clinical and imaging findings are normal and which are associated with symptoms.
Hypothesis: Due to the high rate of low back pain in professional beach volleyball players there is a high incidence of pathological findings in the magnetic resonance tomography, such as degeneration of the intervertebral discs, injuries, pars fractures and spondylolysis compared to the normal population.
Study Design: Cross-sectional study.
Methods: During the Beach Volleyball Grand Slam 2012 Tournament in Klagenfurt, Austria, 29 professional male players underwent a questionnaire-based interview (Roland Morris, SF 36) and a complete physical and neurological examination of their spine, including a MRI of their lumbar spine.
Results: The mean age of the athletes was 28.2 years. 86.2% suffered low back pain, 62.1% during the last year, and 31% during the last 4 weeks. The intensity of pain, rated with the visual analoge scale (VAS 0–10 points) was median 3 points. 25 of 29 (86%) players showed degeneration of intervertebral discs (Pfirrmann Grade >II). Spondylolysis was found in 6 of 29 (13.8%) players. 5 of these 6 had a defect of the pars interartikularis in LWK 5. 6.9% showed a spondylolisthesis Meyerding Grade I .
Only 21% used NSAR on a regular basis, 50 % underwent medical treatment such as PT. All players were fully competitive at the time of examination.
Conclusion: The prevalence of spondylolysis and degeneration of the intervertebral disc in professional beach volleyball players is 13.8%, respectively 86%. This is significantly higher than in the normal aged matched population. Most of the examined, fully competitive players, have suffered low back pain but only few had to intermit training or tournament caused by pain. Therefore, abnormal clinical and imaging findings in the lumbar spine of beach volleyball players should be interpreted with care.
Keywords: lumbar spine, degeneration, lower back pain, professional; sports injury; overuse; volleyball; beach volleyball;

FM56

Clinical & radiological mid-term results of pedicle subtraction osteotomy in 7 patients with previous single level lumbar surgery and global sagittal imbalance

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Introduction: Sagittal balance of the spine is a concept which allows a global biomechanical approach of spinal pathologies. Recent literature has defined different spino-pelvic balance groups, inferring appropriated therapeutic approaches. In this prospective series of 7 patients we outline how disregarding spine balance during previous "simple" lumbar surgery has led to serious pain and disability, necessitating complex corrective surgery a few years later.
Method: 7 patients were admitted for monitored pedicle subtraction osteotomy (PSO) and long fusion for invalidating low back pain (LBP) and global sagittal imbalance as measured by several spino-pelvic parameters including spino-sacral angle (SSA). All had undergone previous posterior single level lumbar decompression and/or fusion, within the last 5 years, and retrospectively felt no improvement. Various perioperative parameters were analyzed. Oswestry disability Index (ODI) and LBP VAS questionnaires were filled up preop and at latest follow up (FU). Radiologic parameters of sagittal balance and magnitude of correction were compared between preop and latest FU, on standing full-spine low-dose XR.
Results: 7 patients undergoing a PSO were included for analysis, mean age 66 (57–78), 6 women, 1 man. Latest mean follow-up was 10 month (range 6–24 m). Mean OR time was 383 min (210–540), mean estimated blood loss (EBL) 2008 ml (360–3500). Mean preop ODI was 65%, mean postop ODI was 32% ($p < 0.05$). Mean preop LBP VAS was 8.6/10, postop 2.7/10 ($p < 0.05$). Mean preop spino-sacral angle (SSA: holistic measure of sagittal balance) was 109°, mean postop 123° (normal = 130°+/–8°), showing restoration of balance. Complications: one patient suffered from ischemic cervical myelopathy with an EMS score of 13/16 (mild impediment), all the others from anemia necessitating blood transfusion. One patient has persistent LBP and insufficient lordosis correction with pseudarthrorsis and will need further surgery.
Discussion: Spinal sagittal balance is a capital factor not to be ignored when planning spine surgery. Failure to take it into account can lead to short time benefit, functional deterioration and the need for significant complex corrective surgery as in these 7 patients. Restoring their sagittal balance was correlated with functional and symptom improvements of the patients at 10 month FU.

FM57

Ponseti Treatment in older and previously treated child using below knee semi-rigid fiberglass cast (SoftCast®): efficiency and limits

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Introduction: Long leg casting is necessary in newborns for proper foot fixation during clubfoot treatment. We use SoftCast® for Ponseti treatment since 2001 and did not appreciate any difference in terms of duration of treatment compared with regular plaster cast. SoftCast® is lighter and easier to remove. To improve compliance we also use fixation below the knee in children older than 2 years allowing the child to walk free during treatment. The purpose of this study is to evaluate the efficiency of Ponseti treatment in difficult situations such as relapsed or previously treated clubfeet in older children using fixation with below knee Soft Cast®.
Methods: 38 feet of 28 patients (23 boys, 5 girls) with residual clubfoot deformity were treated by Ponseti technique with fixation with below knee SoftCast® until full correction or no further progression of correction was achieved. In some cases in older children the goal of treatment was just improvement of foot position and joint mobility to reduce operative steps and complications.
Results: Mean age at onset of treatment was 4.6 years (2–15). Mean follow up was 3.1 years (0.4–9.7). 3–14 casts (average 7) were needed. Mean treatment duration was 10.4 weeks (5–20.1). Change of casts were usually done after 10 days (6–16). On 27 feet (71%) of 21 patients (75%) full correction could be achieved after 8 casts (9.8 weeks). Of this group 6 feet (22%) on 5 patients (24%) needed additional tenotomy of tendon Achilles during treatment. 11 feet (41%) of 7 patients (33%) of this group developed partial relapse which needed further treatment. 11 feet (29%) in 7 Patients (25%) needed additional limited surgery after Ponseti treatment (tibialis anterior transfer or/and additional bony procedures).
Conclusions: Ponseti Method is extremely efficient even in older children and particularly difficult situations. With only exception of feet who showed severe stiffness due to secondary joint deformity (all previously operated) Ponseti Method is powerful enough to reduce deformity completely reduce its severity and improve joint mobility allowing less invasive surgery. We believe that in children older than 2 years fixation below the knee joint, which is allowing free gait, can be as efficient as long leg cast fixation. Perfect modeling around the ankle joint is mandatory.

FM58

Quadricepsplasty for congenital dislocation of the knee and congenital contracture

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Introduction: We encountered problems with the Curtis & Fisher technique of quadricepsplasty for congenital quadriceps contracture including wound dehiscence, insufficient lengthening of the quadriceps and instability of the knee. We modified the operative technique to address these three problems. We undertook this study to evaluate the results of the modified technique of quadricepsplasty to determine if we succeeded in overcoming these limitations of the original technique.
Methods: Twenty children (33 knees) underwent the modified Curtis & Fisher quadricepsplasty through a lateral incision; a long tongue of the rectus femoris was raised and the vasti mobilised without dividing the lateral retinaculae till the collateral ligaments. The children were followed up for a mean period of 63 months and evaluated. The healing of the wound, active and passive range of motion of the knee, the stability of the knee, quadriceps power and knee function were assessed.
Results: Primary wound healing occurred in 32 of 33 knees. Adequate lengthening of the quadriceps sufficient to facilitate knee flexion to 90 degrees was possible. Considerable improvement in the range of motion was noted. In non-syndromic congenital dislocation of the knee (CDK) the quadriceps power was Grade 5 but, minor degrees of extensor lag was noted. In a proportion of patients minor degrees of joint instability was present. The majority of children were community walkers. The overall results were better in non-syndromic CDK than in children with arthrogryposis but differences of some variables were not significant.
Discussion: The modifications to the original Curtis & Fisher technique overcame the specific problems they were expected to avoid.

FM59

3D gait assessment in children with cerebral palsy using foot-worn inertial sensors

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Introduction: A child's natural gait pattern may be affected by the gait laboratory environment. Wearable devices using body-worn sensors have been developed for 3D gait analysis. The purpose of this study was to validate and explore the use of foot-worn inertial sensors for 3D gait measurement in independently walking children with cerebral palsy (CP).
Method: We performed a case-control study. We analysed 14 children with CP old and 15 controls, aged 6 to 15 years old. Two U-shaped and two 8-shaped trial walks per subject were performed during which accuracy and precision of the foot-worn device was measured using an optical motion capture system (Vicon,Oxford Metrics) as the reference system. All subjects then performed a continuous 200-meter walk wearing the foot-worn inertial sensors (Physilog III, LMAM-EPFL, Switzerland). Limb-related spatio-temporal parameters were compared between paretic and control limbs while bilateral gait characteristics were compared between CP and control subjects, using nonparametric analyses.
Results: Mean accuracy ± precision for both groups was 3.4 ± 4.6 cm for stride length, 4.3 ± 4.2 cm/s for speed and 0.5 ± 2.9° for strike angle. Gait spatio-temporal parameters showed longer stance and shorter swing phases with an increase in double support in children with CP ($p = 0.001$). Stride length, speed and peakswing angular velocity were decreased in paretic limbs, with significant differences in strike and lift-off angles. Children with cerebral palsy showed significantly higher intra-individual variability (measured by their coefficient of variation) for speed, stride length, swing and stance phases. During turning trajectories speed and stride length decreased significantly ($p < 0.01$) for both groups, whereas stance increased significantly ($p < 0.01$) in CP children only
Conclusion: Foot-worn inertial sensors allowed us to analyze gait kinematics outside a laboratory environment with a good accuracy and precision. The case control comparison yielded results which were congruent with what is known of gait variations in children with cerebral palsy who walk independently. Participants found the system light weight and easy to wear and use. While not substituting for complete 3D gait analysis, portable sensors provide precise information about gait in conditions that are closer to the child's habitual environment and motor behaviour, and could therefore prove to be a useful complement.

FM60

Analysis of osseous and cartilaginous acetabular angles on MRI in children

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Introduction: In patients with developmental hip dysplasia (DDH) a plain radiography of the pelvis can show an insufficiency of osseous acetabular coverage of the femoral epiphysis but we are not able to quantifiy the quality of the real coverage of the femoral head consisting of the acetabular bone, cartilage and labrum. The MRI allows a good tissue differentiation between the bone, the cartilage and fibrous tissues. The measure of the cartilaginous angle of Hilgenreiner (HTE) appreciates the morphology of the cartilaginous borders of the acetabulum, which will gradually ossify with growth. This cartilaginous HTE appreciates the theoretical cover at the end of growth.
We performed coxometric analysis of the cartilaginous and osseous limits of the acetabulum on frontal MRI imaging from healthy and dysplasic hips.
Material and Method: We included 30 children (mean age 5y) who had a MRI imagery of both hips. The diagnoses for the 60 hips were 22 healthy hips, 11 hips treated for Perthes disease and 27 hips with DDH. We measured the cartilaginous and osseous angles of Hilgenreiner (HTE) on both hips on T2 weighted frontal images where the centers of the femoral epiphysis were best seen. We calculated then the ratio of the square of cartilaginous HTE (C^2) above the osseous HTE (O). This ratio C^2/O expresses the residual cartilaginous growing-potential of the acetabulum.
Results: For the healthy hips, the ratio varies from 0.75 to 6.78. 81% of these hips show a ratio lower than 5. The hips with DDH show a ratio from 4.73 to 14.9 with 95% higher than 5, including 23% that have a ratio above 10. The hips with Perthes disease show a mean ratio of 2.75, with only one hip above 5.
Discussion: If we consider a hip at the end of growth, the value of the osseous angle tends towards that of the cartilaginous angle; the ratio C^2/O is then equivalent or inferior to the osseous HTE. The mean value of this angle at the end of growth was evaluated by Bédouelle et al. at 12° at the age of 8–10 years and for younger children between 15–20°. The trial shows a theorical "normal" value for this cartilaginous

HTE inferior to 10° . This angle is corroborated with the average values we obtained from the 22 healthy hips and the 11 hips with Perthes. The hips with DDH in our study have 88% cartilaginous HTE above 10° and a mean value of 14.2°.
Conclusion: The ratio C^2/O enables us to classify the hips in 3 categories: Group A includes hips with a ratio inferior to 5. Group B includes hips with a ratio from 5 to 10 and group C includes hips with a ratio above 10. Goup A represents the hips with a great potential of standardization with growth. Group B includes hips that have less optimal correction potential, but still have a chance of normalization with growth and Group C represents severely dysplasic hips in which the cartilaginous potential of growth is insufficient and where a surgery of reorientation of the acetabulum is indicated.
In future, estimation of cartilaginous and osseus angles based on MRI imaging could help evaluate the indication of a pelvic osteotomie for acetabular reorientation in children with residual developmental hip dysplasia.

FM61

Loss of a condyle of the femur or tibia following septic arthritis in infancy: problems of management and testing of a hypothesis of pathogenesis

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Introduction: The study was undertaken to i) describe the characteristic radiological features and problems of management of the loss of one condyle of the femur or tibia following septic arthritis of the knee in infancy and ii) to test a hypothesis of the cause of the loss of a single condyle.
Methods: Radiographs of eight children with loss of one condyle of the femur or the tibia following septic arthritis in infancy were reviewed. The course and outcome in two of these children who underwent reconstructive operations were studied. Knees of 35 stillborn foetuses were dissected to determine if presence of synovial septae could account for isolated loss of one condyle following infection.
Results: All eight cases showed characteristic features of loss of half the epiphysis, the underlying physis and part of the adjacent metaphysic; the other condyle was totally spared. The two children who underwent elaborate reconstructive procedures had poor outcomes at skeletal maturity despite a series of additional operations. The foetal cadaveric study showed that complete infrapatellar synovial septae are present in some foetuses approaching 40 weeks of gestation.
Discussion: The pattern of loss of a femoral or tibial condyle following septic arthritis is consistent with total preservation of the other condyle. The outcome of surgical reconstruction of the missing condyle is poor. The presence of a complete synovial septum could result in localisation of infection to one half of the joint with destruction of one condyle.

FM62

Temporary hemiepiphysiodesis of the distal medial femur – Is the MPFL in danger?

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Introduction: Severe postoperative pain or decreased range of motion after temporary hemiepiphysiodesis with plates on the distal medial femur is a condition rarely described in literature. It can lead to prolonged hospitalisation with intensive need for physiotherapy. As the femoral insertion of the medial patellofemoral ligament (MPFL) is located close to the medial femoral epicondyle and physis, this structure potentially is in danger by the surgical approach. We hypothesize a high occurrence of iatrogenic damage to the MPFL or trapped soft tissues by the plate and therefore to be the reason for reduced range of motion or pain.
Methods: In eight cadaveric knees (3 right, 5 left knees, mean age 78y) of six specimens a 3.5 mm two-hole one-third tubular plate was implanted under fluoroscopic guidance in the area of the distal medial physis of the femur in a standardized surgical technique. The following dissection revealed trapped tissue by the plate and the integrity of the MPFL. The plate position was classified to be either extra- or intraarticular.
Results: The MPFL was completely cut in 2 of 8 cases. In 4 of 8 cases the MPFL was trapped under the plate. In only 2 cases the MPFL was neither damaged nor trapped and no capsular or synovial tissue was pinged by the plate, which was therefore classified as extraarticular. In 4 knees the plate was placed partially intraarticular by injuring the joint capsule and fixing synovial tissue. 6 of 8 knees showed therefore affection of underlying tissue.
Conclusion: The MPFL is the most common injured or trapped anatomical structure in this cadaveric study. Despite correct plate insertion for hemiepiphysiodesis, these results assume an explication for prolonged postoperative pain and decreased range of motion in patients treated with this technique.

FM63

A novel treatment for osteochondritis dissecans of the knee: Introducing the 'doorstop phenomenon'

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Introduction: Osteochondtitis dissecans (OCD) of the knee in paediatric patients is a relatively common problem that can be difficult to treat. We hypothesised that a key aetiological factor may be instability of the meniscus whereby the free peripheral edge of this meniscus acts as a 'doorstop' jamming between the femoral and tibial condyle inducing a repetitive trauma which over time results in the typical OCD lesion. We tested this hypothesis by stabilising the meniscus only as treatment for OCD in 10 knees.
Methods: Prospective case series. 11 knees in 10 patients with a mean age of 13 years with symptoms (mean of 18 months) had an MRI confirmed diagnosis of OCD. At arthroscopy all were found to have an unstable anterior meniscus which was stabilised with an out-in suturing technique. Patients were assess by functional scoring and radiographically by MRI both preoperatively and postoperatively. Mean follow up was two years.
Results: 4 cases demonstrated complete healing radiographically at 3 months, 3 more cases were healed on MRI by 6 months and all had complete resolution on MRI by 1 year. Subjectively all patient reported their knee as 'much improved'. The Hughston score improved significantly in all and had reached normal levels by 1 year. 2 complications were reported: 1 infection and 1 traumatic failure of suturing requiring reoperation
Discussion: The aetiology of OCD is unclear but we clearly demonstrate that treating an associated unstable meniscus alone can result in complete resolution radiographically of the OCD along with excellent improvement in patient related outcome measures**.**

FM64

Rim Instability in Lateral Discoid Meniscus

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Introduction: Rim instability is recognised as an additional problem in treating discoid meniscus. Often this condition leads to a repair of the detached peripheral attachment. The aim of this study was to determine the prevalence of peripheral rim instability in lateral discoid meniscus.
Methods: A consecutive series of 65 knees (53 patients, mean age 10y, range 4 to 16y) underwent arthroscopy for symptomatic lateral discoid meniscus between 1991 and 2013. Intraoperatively the meniscus was classified in size (complete or incomplete discoid morphology). The stability anterior, lateral corpus and posterior was tested with probing to assess evidence of hypermobility. Data were analyzed using the Student t-test for continuous data and the Fisher exact test for categorical data.
Results: 38 (58,5%) were classified as complete discoid lateral menisci (Group A) and 27 (41,5%) as incomplete (Group B). 49% (n = 32) of all menisci were instable (17 incomplete). No significant difference was detected between this two groups (p >0,05). The anterior part of the meniscus showed lack of stability in 23 cases (72%), the corpus in 14 (44%) and the posterior part in 20 cases (63%). Thirteen were unstable only in one part of the meniscus (8 anterior, 25%; 5 posterior, 15,6%). Twelve were unstable in two parts of the meniscus (in each case 4, 12,5%; anterior and corpus; corpus and posterior; anterior and posterior), and in seven cases (22%) the whole lateral meniscus was affected. No significant difference were deteced (p >0.05). No age related differences in stability was found (p >0.05).
Conclusion: This study shows a high rate of rim instability in discoid lateral meniscus. According to this findings a precise examination of the rim stability intraoperatively is recommended and therapy of instability is necessary.

FM65

The Anterior Intermuscular Septum. A suitable guideline in the course of the superficial peroneal nerve

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Introduction: Variable location of the superficial peroneal nerve (SPN), either in the lateral or anterior compartment of the lower leg, and risk of its damage during surgery should be considered. However, we currently lack a clear strategy as to where and how the SPN can be located most effectively. From clinical routine the close proximity of the SPN to the anterior intermuscular septum (AIS) is known, however, the exact relationship between these two structures has not been comprehensively investigated. Thus, the aim of the present study was to view the SPN in relation to the AIS and to determine whether that would be of practical value for a safe technique for SPN dissection.
Methods: 164 SPNs were dissected in 137 cadaver legs of 72 specimens. The entire course of each SPN was recorded and described with respect to the AIS at two points on the fibula (x/3 and 2x/3, × being the length of fibula). 1) the distance where the SPN runs adjacent to the AIS, 2) the distance between the point x/3 and the point where SPN pierces the AIS and 3) the distance between the point 2x/3 and where the SPN pierces the AIS were calculated.
Results: In 68.6% (94 cases) the SPN coursed in the lateral compartment (lateral leg-type), in 11.7% (16 cases) in the anterior compartment (anterior leg-type) and in 19.7% (27 cases) in both the anterior and lateral compartments (intermediate leg type). 80.5% of the 164 traced SNPs coursed in the lateral and 19.5% in the anterior compartment. At the point x/3 the SPNs were consistently found in close proximity or adjacent to the AIS; 0 to 10 mm and 0 to 18 mm respectively. At the point 2x/3 the SPNs coursed a distance of 0 to 26 mm from the AIS.
Conclusion: In the majority of patients the SPN can be localised 1/3 of the fibula length proximal to the lateral malleolus adjacent or very closely lateral to the AIS. In the remaining cases the SPN can be found medial to the AIS. The localization of the AIS is a simple procedure and can be achieved even under difficult conditions such as trauma, swelling, or after previous surgery with scarring. Therefore, the AIS can be used as a suitable landmark while performing a dissection of the SPN.

FM66

Visualization of the Talar Dome by Anterior versus Posterior Ankle Arthroscopy: A Cadaver Study

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Introduction: Arthroscopy has become a valuable and important diagnostic and therapeutic procedure for treatment of pathology of the tibiotalar and more recently the posterior subtalar joint. Although the safety of portal placement for posterior ankle and subtalar arthroscopy has been shown in anatomic studies, little is now about the visualization and accessibility of the talar dome by posterior ankle arthroscopy. Therefore, the objectives of this study were to (1) assess the visualization of the talar dome through anterior versus posterior arthroscopic approaches with the standard non-invasive distraction, and (2) assess the effect of the minimally invasive calcaneal distraction.
Methods: We used 14 matched fresh cadaveric thigh to foot specimens. The mean age of the cadavers was 54.3 ± 9.0 years (range, 38 to 63 years). The order of the arthroscopic procedure (anterior vs posterior) and use of a distraction method (non-invasive vs minimally invasive) has been randomly determined using a computerized random number generation. The visualized area has been marked using a ring curette (anterior ankle arthroscopy) or an electrocautery (posterior ankle arthroscopy). After the arthroscopies the tibiotalar joint was disarticulated and previously marked areas were analyzed.
Results: The mean talar sagittal length was 45 mm (range, 43 to 50 mm), the mean total talar area was 1220 mm^2 (range, 1043 to 1443 mm^2). In specimens with non-invasive distraction the accessibility of the talar dome was greater using anterior approach than posterior approach ($p = 0.007$). The use of minimally invasive distraction did not change the accessibility of the talar dome in specimens with anterior ankle arthroscopy with 743 ± 180 mm^2 vs 716 ± 240 mm^2, respectively ($p = 0.590$). In specimens with posterior ankle arthroscopy the use of minimally invasive distraction significantly increased the talar dome accessibility with 480 ± 178 mm^2 vs 703 ± 269 mm^2, respectively ($p = 0.031$).
Conclusion: Intraarticular pathology in the anterior 60% of the joint can be well addressed via anterior ankle arthroscopy using standard distraction technique. Lesion located more posterior are better addressed via posterior arthroscopy: calcaneal pin distraction may increase the articular visualization.

FM67

Foot biomechanics and muscle activation during walking after joint preserving realignment surgery for asymmetric ankle osteoarthritis

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Introduction: Osteoarthritis (OA) of the ankle is often asymmetric with a hindfoot malalignment into varus or valgus. Patients often have partially intact articular cartilage and can benefit from joint preserving realignment surgery with hindfoot and supramalleolar osteotomies. The purpose of this study was to quantify bilateral biomechanical and neuromuscular adaptations during walking in patients with asymmetric ankle OA before and after realignment surgery.
Methods: A 3D gait analysis with bilateral surface electromyography (EMG) of gastrocnemius medialis, soleus, peroneus longus, and tibialis anterior was performed in: 7 patients with asymmetric ankle OA before (P1a) and 12 to 18 months after surgery (P1b), 7 other patients 8 to 9 years after surgery (P2), and 15 healthy subjects (C). For each subject 6 trials were recorded. EMG envelopes of each muscle were analyzed using principal component analysis (input: 101 time points x 432 trials). The first 2 principal components (PC) scores, kinematic, and kinetic parameters were averaged for each leg and subject and compared between the groups using ANOVA ($P<0.05$).
Results: The range of motion of the affected foot was significantly reduced in hindfoot dorsiflexion (C: 22.6 ± 4.1°; P1a: 15.3 ± 5.3°; P1b: 11.1 ± 5.3°; P2: 13.3 ± 3.7°) and forefoot supination (C: 12.4 ± 2.4°; P1a: 9.5 ± 3.1°; P1b: 7.5 ± 1.8°; P2: 8.7 ± 2.3°) in all patient groups. The peak ankle plantarflexion moment was significantly lower for both legs in P1a (OA ankle: 1.4 ± 0.3 Nm/kg; healthy ankle: 1.5 ± 0.2 Nm/kg) and P1b (1.1 ± 0.2 Nm/kg; 1.3 ± 0.2 Nm/kg) patients than in controls (1.7 ± 0.1 Nm/kg). PC1 of gastrocnemius medialis altered the peak activation and the PC scores were significantly lower than in controls in P1a (both legs) and P1b (affected leg) patients. For soleus, PC1 scores (peak activity) were lower for the affected leg in the P1a patients.
Conclusion: The biomechanical changes were likely related to a reduced mobility of the ankle joint. Long-term follow-up patients (P2) showed fewer changes in their gait pattern, especially for the temporal muscle activation. This could indicate that one year after surgery patients were still adjusting to the altered biomechanics. As clinical results already showed reduced pain and improved quality of life, the present study suggest that realignment surgery is a worthwhile alternative treatment option for patients with asymmetric ankle OA.
Acknowledgement: This study was supported by SNF grant 3200BO-120631.

FM68

Timed unilateral vs. simultanous bilateral hallux valgus correction surgery: Prospective analysis of clinical outcome and socioeconomic considerations

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Introduction: Hallux valgus correction is one of the most commonly performed procedures in forefoot surgery. Recent surgical methods allow full weightbearing in postoperative follow-up, enabling surgeons to perform simultaneous bilateral surgery. The presented prospective case series aims to analyze short-term follow-ups after unilateral and bilateral bunion correction with special regards to clinical outcome, patient acceptance and cost effectiveness.
Methods: Distal metatarsal ReveL-osteotomy combined with proximal phalanx Akin osteotomy was performed in 130 patients (Group 1: unilateral N = 65; Group 2: bilateral N = 65). Patients with additional corrective forefoot surgery were excluded from analysis. Preoperative AOFAS scores were compared to scores at 6/12 weeks and 1 year after surgery. Intermetarsal (IM), hallux valgus (HV) and distal articular (DMAA) angles were measured pre- and postoperatively. A 2-years phone follow-up regarding patient satisfaction was performed. Direct and indirect costs were estimated by analyzing hospitalization parameters and postoperative professional incapacity.
Preliminary results (25 patients per group): Improvement in AOFAS was comparable in both groups, group 2 even showing a tendency for quicker recovery at 6 weeks ($\Delta1$: +16.8 ± 12.2; $\Delta2$: +24.2 ± 16.8; $p = .12$). Improvement of measured angles did not differ (IM: $p = .57$, HV:

p = .78, DMAA: p = .56). Bilateral bunion correction displayed a tendency to longer hospitalization time (Group 1: 2.3 days ±1.2; Group 2: 2.9 days ±2.2; p = .071) and more opiate requirements in postoperative recovery (Group 1: 7.8 mg ± 6.3; Group 2: 11.1mg ± 9.2; p = .093). Patient satisfaction was high in both groups, with every patient in group 2 willing to undergo bilateral surgery again. While physical duty demands longer away-from-work time than sitting (p <.05) or standing/walking duty (p <.05) in both groups, patients with bilateral hallux correction were not lost to work longer than their unilateral counterparts (p = .27).

Conclusion: Intrinsically stable surgical techniques encourage simultaneous correction in symptomatic bilateral hallux valgus deformity. Bilateral surgery did not affect outcome and displayed a high level of patient acceptance and satisfaction. While being more costly in direct comparison to single sided bunion correction, staged bilateral correction will essentially double unilateral surgery's expenses. Thus, simultaneous hallux correction contributes to direct and indirect cost reduction.

Free communications VI – Special topics: tumours / basic research / quality assurance

FM69

Laparascopic assisted resection of an ileosacral chondrosarcoma

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Rationale: According to contributions of Yonamine we have begun to resect sacral tumors with video-laparascopic exposure of the anterior structures.
Patient: A 33year old woman 6 weeks after her second normal vaginal delivery complained of lumbosacral dysesthesia. Imaging showed a mass oft he sacrum crossing the ileosacral joint suggestive of a chondrosarcoma, after biopsy graded GI, calculated volume 700 cc.
Technique: The procedure was performed in an unstable lateral decubitus starting with the anterior laparascopic exposure of the os sacrum and the right pelvic sidewall by passing through right pararectal space and full mobilization of the rectum from the promontorium downwards to the pelvic floor. After transection of the sacral hypogastric fascia, the medial and caudal limits of the tumor and as well as the SNR were identified. While the sacral nerve roots L5 - S2 attached on the tumor, while S3 and S4 were free. Full exposure of the pelvic ureter followed by the coagulation and transection of the internal iliac and the lateral sacral vessels. All cardinal vessels below the tumor were also transected including the pudendal and inferior gluteal vessels. The dissection of the lumbosacral space enabled the exposure of the lateral limits of the tumor and identification of both the obturator nerve and the sciatic just before it entry through the great sciatic foramen. 2 Gigli saws were inserted from anterior to posteriorly, one through foramina L5 and S1, the other through S1 and S4 for transection of the sacrum under visual endoscopic control. The resection of the ileum was performed in analogy to a Judet approach externally.
For reconstruction the defect was replaced with a massive allograft and stabilisation performed by lumbo-ischial screw and rod fixation. The total blood loss was judged to be about 1000 cc; the total replacement were 2 units of blood.
Results: Pathologic examination showed uncontaminated margins.
Conclusion: We have got the impression, that the anterior video-laparascopic approach presents several advantages by giving a superior view, higher precision and decreased blood loss for tumors in this anatomical difficult location of tumors.

FM70

In vivo monitoring of osteosarcoma primary tumor growth using fluorescent and Luciferent imaging

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Introduction: In osteosarcoma (OS), monitoring of metastases is very important, as this is the most important prognostic determinant of patient death. In our laboratory, we study OS in several mouse models. Using our lacZ tagging technique (Arlt et al., J Vis Exp. 2012) we can monitor metastases formation, but only ex vivo. Also, necrosis inside the primary tumor can overestimate tumor volume and the true amount of living tumor cells. We therefore looked into additional techniques to monitor primary tumor growth and metastasis formation in vivo. Here we present results of an experiment where OS tumor cells were tagged with the light-producing enzyme Luciferase (Luc), or the fluorescent proteins mCherry (mCh) or dsRed (dsR), in addition to our lacZ tag.
Methods: Female SCID mice were intratibially injected with either Luc/lacZ, dsR/lacZ, or mCh/lacZ tagged osteolytic 143B OS cells. Mice were scanned every week in the IVIS Lumina XR to monitor Luc, dsR and mCh presence, and primary tumor sizes were measured using caliper and micro-CT. To monitor Luc presence, mice were injected with substrate (Luciferin) immediately prior to measuring. For mCh and dsR monitoring, excitation wavelengths were 557 nm for dsR, and 587 nm for mCh. Scans took between 10–15 min, with two mice scanned simultaneously. After 28 days the animals were sacrificed, lungs were excised, stained for lacZ presence, and both macro (>0.1 mm) and micro metastases (<0.1 mm) were counted.
Results: Already 24 hrs after injection of the Luc tagged tumor cells a clear Luc signal was obtained in the hind limb, which increased further over time and peaked 28 days after tumor cell injection, at which time point lung metastases could also be detected. The dsR signal could only be detected after 28 days due to a high unspecific autofluorescent signal. mCh tagged tumors had an intermediate sensitivity. Unexpectedly, tumor sizes were significantly smaller in Luc tagged tumors compared to dsR and mCh tagged tumors, and mice injected with dsR tagged tumor cells had a larger amount of macrometastases. We found a strong correlation between caliper-measured and micro-CT measured tumor volumes.
Conclusions: Luciferase tagging is a very sensitive technique to monitor living tumor cells. Fluorescent mCherry tagging yielded the most consistent signal during primary tumor growth, whereas dsRed tagging was found to be unsuitable. These techniques allow us to monitor primary tumor growth and metastasis formation in vivo.

FM71

Computer-aided matching of multimodal tomographic data for improved diagnostics and more accurate osteotomy planning in the oncological pelvic surgery

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Introduction: Planning of tumor resection in the oncological pelvic surgery involves usually multimodal tomographic imaging data. For pelvic osteotomy planning in case of pelvic bone tumors or soft tissue tumors infiltrating bones the computed tomography (CT) and the magnetic resonance imaging (MRI) data are principally used. In the context of diagnostics the nuclear medicine imaging methods like SPECT or PET play also an important role. Magnetic resonance angiography (MRA) could be helpful for evaluating the proximity of bone tumors to vascular structures. All these medical imaging modalities deliver complementary but uncorrelated diagnostic information. For its optimal use at the diagnostics stage and in the surgery planning, it is necessary to align and to correlate all the acquired imaging data. Up to now the correlation of the multimodal information is performed by the surgeons mainly mentally. The objective of this study is to investigate if and how the computer-aided matching of multimodal tomographic data can improve the diagnostics and the oncological pelvic osteotomy planning.
Methods: For computer-based correlation of the multimodal tomographic data several numerical matching methods have been developed and implemented. Two main classes of 3D data matching procedures have been applied in our study: voxel-based methods (based on the mutual information function) and surface-based methods (surfaces of anatomical structures have to be segmented in the data pre-processing phase). For an effective evaluation of the diagnostic-relevant matching results and an optimal osteotomy planning numerous advanced data visualization methods have been applied. A similar data processing pipeline has been performed in 8 oncological pelvic osteotomy planning cases.
Results: For each of these 8 cases at least one pair of multimodal tomographic data has been matched. In the majority of cases the multimodal data pair consisted of CT and MRI data. The matched datasets have been inspected and analyzed by the 2D and 3D visualization methods. For instance, 2D slice-view of one modality with free-movable small inspection window inside, showing the correlated grey-value information from the second modality. Other example is 3D volume rendering of one modality showing the tumor and the soft tissue information mixed with the 3D surface rendering of osseous structures segmented in the aligned second modality. In addition, the

implemented virtual cutting tools allow performing more accurate osteotomy planning on the segmented 3D surface models due to numerical, not mental, data correlation. All this can be controlled in a full interactive way. The advantages of the proposed osteotomy planning method over the traditional approach have been confirmed in all 8 cases.
Conclusion: In all tested cases the new system demonstrated significant superiority over the traditional pelvic osteotomy planning based on the mental tomographic data correlation and 2D slice viewing. The proposed oncological pelvic osteotomy planning method has potential to become the method of choice for this class of surgery planning approaches.

FM72

Biomechanical comparison of five different external fixation configurations for pelvic ring instability

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Objective: External fixation is useful in the primary treatment of pelvic ring injuries. The present study compared the biomechanical stability of five different configurations of an external pelvic ring fixation system.
Methods: Five configurations of the same anterior external pelvic ring fixation system were tested on pairs of Polyoxymethylene testing cylinders using a universal testing machine with n = 3 for each sample group. One single connecting rod was used in group SINGLE, two parallel connecting rods in group DOUBLE, two and four rods, respectively, in a tent-like configuration in groups SINGLE TENT and DOUBLE TENT and four rods in a rhomboid-like configuration in group RHOMBOID. Each specimen was subjected to a total of 2000 consecutive cyclic loadings at 1 Hz with sinusoidal lateral compression/distraction (+/-50 N) and torque (+/- 0.5 Nm) loading alternating every 200 cycles. Translational and rotational stiffness were determined at 100, 300, 500, 700 and 900 cycles.
Results: The SINGLE TENT and RHOMBOID configurations already failed with a preloading of 50 N compression. The DOUBLE configuration had around twice the translational stability at 100, 300, 500, 700 and 900 cycles when compared with the SINGLE (p = .002,.003,.005,.000, and .000) and DOUBLE TENT (p = .001,.001,.001,.000,and .000) configurations. Rotational stiffness observed for the DOUBLE and DOUBLE TENT configurations was about 50% higher when compared with the SINGLE configuration at 100 (p = .024/.012), 300 (p = .019/.074), 500 (p = .031/.011), 700 (p = .003/.005) and 900 cycles (p = .004/.006).
Conclusion: Using two parallel connecting rods for external pelvic ring fixation provides the highest translational (lateral compression/distraction) and rotational (bending of the hip) stability.

FM73

Return to sport after hip arthroplasty – an EMG study

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Introduction: An increasing number of patients suffering from osteoarthritis are young and expect from a hip arthroplasty not only to regain a complete pain relieve but also to return to a normal sport activity including running. Most surgeons allow their patients to start running 5 to 6 month after the operation. Is this period long enough to allow sufficient hip muscle recuperation?
Methods: Twelve patients between 55 and 65 years with a mean follow up of 4 years (6 months to 8 years) after hip arthroplasty were included in this study. All had been practicing running regularly before having developed osteoarthritis and all had continued after the operation. Spatio-temporale parameters were extracted at different velocity with 3-dimensional accelerometers and gyroscopes on the feet. Simultaneously the muscle activity of the gluteus maximus, the gluteus medius and the rectus femoris of both sides were recorded with EMG sensors. The parameters were validated with 4 healthy control subjects.
Results: All participants had started again to run regularly six months after the operation. Six to twelve months after the operation, the EMG signal shows a high variability and the eccentric contraction of the hip muscles were not clearly perceivable. At 12 months, the EMG-signal of the gluteus maximus becomes progressively more regular and between 1 and 2 year, the one of the gluteus medius. 2 to 3 years postoperative the peaks of the eccentric contraction of the three hip muscles are again attained simultaneously.
Conclusion: The simultaneous measurement of the EMG of the three main hip muscles allows to detect the stepwise normalization of their function after hip arthroplasty. A well coordinated eccentric contraction of the extensor muscles reduces the transmission of excessive forces up to the hip joint during running. An intensive reinforcement of the hip muscles is mandatory after hip arthroplasty. Before starting to run again, at least the eccentric contraction of the gluteus maximus should be normalized.

FM74

Range of Motion Analysis for the Design Optimization of a Bi-Directional Total Hip Endoprosthesis

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Introduction: After total hip arthroplasty, dislocation is one of the most frequent serious early complications. This occurs in part due to impingement (catching and leverage of the neck-cup on the inlay/cup border). Impingement may also negatively impact long-term outcomes.
Materials and Methods: A preliminary model for an optimized hip endoprosthesis system was developed to offer a mechanical solution to avoid impingement and dislocation. A computer-supported range of motion simulation using parameters of cup anteversion and inclination as well as torsion and CCD shaft angle was then performed to localize areas of anterior and posterior impingement of typical acetabular cups.
Results: Through isolation of the two main trajectories of motion, and modifications with corresponding gaps to the inlay/cup areas as well as oppositional banking in the abduction/adduction plane, the combination of a snap-fit acetabular cup with reduced cup profile was the result: the “bidirectional total hip prosthesis.”
Under standardized parameters, the ranges of impingement for typical implants are not directly opposite one another (at 180°), but are found instead at an angle of 108.3°.
Conclusion: Complications such as dislocation and impingement may possibly be avoided with the bidirectional total hip prosthesis. Typical implantation parameters yield an implant design with rotational asymmetry.

FM75

The Fifth Muscle of the Quadriceps Muscle Group

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Introduction: The quadriceps femoris (Q) is traditionally described as a muscle group composed of the rectus femoris (R) and the three vasti (lateralis, intermedius and medialis). However, clinical experience and investigations of anatomical specimens are not consistent and do not reflect accurately the description of anatomy textbooks. Following careful exposure of the muscle bellies we found an intervening muscle belly (IM) between the vastus lateralis (VL) and the vastus intermedius (VI). The aim of this anatomical study was to clarify, with regards to muscle innervation, whether the intervening muscle we observed was a variation of the VL, the VI, or a separate head of the extensor apparatus.
Methods: Twenty-six cadaveric lower limbs from sixteen specimens were investigated using macro dissection techniques. The limbs of four specimens were cut transversely in the middle third of the thigh. With special attention to the innervation and vascularisation pattern, the architecture of the quadriceps was examined to confirm its anatomy. Additional muscle bellies were sought; all muscle bellies of the Q were traced from their origin to their insertion, and their affiliation was determined.
Results: In all dissections, an intervening muscle (IM) was found between the muscle bellies of the VL and the VI. Similar to the VL and VI, the IM was innervated by independent muscular branches of the femoral nerve and vascularised through separate muscle branches of the lateral femoral circumflex artery. In the proximal aspect this muscle could always be separated easily from the VI. Further distally, at the junction into the tendinous portion, the A of the IM was adjacent to the lateral fasciae of the VI. Before entering the quadriceps tendon (QT), the layers of VL, VI and the IM could be clearly separated. Four morphological types of IM were divided: Independent Type, VI-Type, VL-Type and Combined Type.
Conclusion: This study demonstrated a different architecture of the Q as compared to previous descriptions. There is an additional muscle belly between the VI and VL, which cannot be clearly assigned to the former or the latter. Distal exposure shows that this muscle belly becomes its own aponeurosis (A), which continues distally as part of the QT. To our knowledge, the IM has not been previously described or illustrated in any textbook of anatomy.

FM76

Muscle Imbalance of the Knee Extensors does not affect Patellar Tracking in the ACL Deficient Knee

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Introduction: Aberrant patellar tracking is known to be an important risk factor in the pathogenesis of patellofemoral pain syndrome (PFPS) and patellofemoral osteoarthritis (OA). Although the etiology is still unclear and multifactorial, abnormal tracking of the patella caused by muscular imbalance of the quadriceps muscle is considered to be an important contributing factor [1]. Especially after knee injuries, weakness and atrophy of the knee extensor muscles followed by altered patellar tracking are commonly seen [2]. Quadriceps strengthening exercises focusing on the vastus medialis muscle (VM) have been suggested as a therapeutic approach to retain knee extensor strength balance. However, results of these studies are not consistent. Moreover, data from in vivo experiments looking at dynamic patellar joint kinematics and muscle force are scarce. Therefore the purpose of this study was to evaluate the influence of the loss of the vastus medialis muscle force on patellar tracking in the intact and anterior cruciate ligament (ACL) deficient knee in vivo.
Methods: Eight skeletally mature New Zealand White Rabbits, weighing 6.0 kg ± 0.6 (mean ± SD) were used. The animals were placed in a custom built stereotactic frame rigidly fixed at the hips and the distal femur by bone pins. The experimental trial consisted of active, concentric (con) and eccentric (ecc) movements of the knee joint, ranging from 30 to 90° of flexion (eleven limbs, n = 11). Measurements were first performed with the knee fully intact (intact control); then, the ACL was transected through a medial arthrotomy, and last, the VM was transected to produce a vast muscle force imbalance. Knee extensor forces for all control, ACL and VM transected trials were matched (≤5% difference of peak force) as force is known to affect patellar tracking [3]. For muscle stimulation, a custom made femoral nerve cuff electrode was used. Patellofemoral kinematics (lateral shift, rotation and patellar tilt) were quantified from high speed video (200 Hz, optical resolution 0.08 mm) which measured the displacement of bone pins imbedded rigidly in the patella relative to bone pins in the distal femur. Statistical analysis was performed using a one way repeated measures ANOVA and Fisher's post hoc analysis. Statistical significance was set at $p < 0.05$. Intraobserver repeatability was assessed by analyzing selected trials three times and calculating the associated variance. The study was approved by the Institutional Review Board for Animal Care at the University of Calgary.
Results: VM transection did not alter the patellar tracking, tilting or rotation significantly for any of the force-matched experimental conditions. After ACL transection, patellar tracking occurred more laterally for the concentric and eccentric contractions ($p < 0.001$, mean shift 0.3 mm (± 0.48 mm), and 0.3 mm (±0.51 mm), respectively (figure 1a,b), and caused a significant lateral rotation of the patella ($p < 0.001$, mean rotation 1.8° (±2.2°) and, 2.3° (±1.7°), respectively (table 1). No changes in patellar tilt were seen. In all trials, force-matched contractions were accomplished within 5% of each other. Eccentric contractions resulted in higher force production than concentric, 388 ± 83 Ncm, and 252 ± 78 Ncm, respectively. Mean intraobserver repeatability was 0.1 ± 0.02 mm.
Discussion: Our results suggest that the isolated loss of vastus medialis muscle force does not affect patellar tracking, rotation or tilting compared to force-matched concentric and eccentric movements in the ACL deficient knee. These results concur with previous findings where we analyzed patellar pressure distribution and patellar tracking in the intact and VM transected animal model, but contradict some results in the literature [3–5]. It is not clear if the results obtained here in a rabbit model can be directly translated to the human knee. However, the VM has a similar insertion into the human and rabbit patellae, and the fiber direction of the distal VM is virtually the same (about 45° from the femoral axis) in humans and rabbits, suggesting that the current results should be considered carefully in future interpretations of knee extensor imbalance in humans.
Significance: Our study is the first to investigate patellar tracking in vivo in the ACL deficient knee superimposed with a selective and controlled muscle imbalance. The findings of this study suggest that muscle imbalance in the ACL-deficient knee does not affect patellar tracking, as has been found previously in the intact, stable knee of rabbits. Therefore, strengthening of the VM in patients with patellar mal-tracking might not restore normal tracking patterns, as has been suggested in the past.
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FM77

Increased macrophage infiltration and trap activity characterize subchondral bone sclerosis in knee ostreoarthritis

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Background: Recent investigations have provided substantial evidence that distinct molecular and morphological changes in subchondral bone tissue, most notably sclerosis, play an active and important role in the pathogenesis of OA. The cellular and molecular regulation of this pathological process remains poorly understood.
Objectives: We investigated whether osteoimmunology, the reciprocal signaling between cells from the immune and bone system, is involved in OA subchondral bone sclerosis.
Methods: Tibial plateaus and informed consent were obtained from patients undergoing total knee arthroplasty due to end-stage OA. Subchondral bone mineralization distribution was analyzed using computed tomography osteoabsoptiometry (CT-OAM) and standardized cryosections of low (non-sclerotic) and high (sclerotic) bone mineralization were prepared (n = 18 each). Cartilage degeneration was graded in Safranin-O-stained sections using the Mankin scoring system. The presence of T-lymphocytes, B-cells and macrophages was assessed using immunohistochemical staining of their respective surface markers CD3, CD20 and CD68. Osteoclast activity was visualized by staining of the enzyme marker tartrate-resistant acid phosphatase (TRAP). Cellular characterization of ex vivo subchondral bone outgrowth cultures was performed using alkaline phosphatase (ALP), TRAP staining. Correlation between histological parameters was assessed using Spearman's rank correlation. Statistical differences were calculated using Wilcoxon signed rank test or paired t-test, where appropriate.
Results: CT-OAM revealed a heterogeneous distribution of subchondral bone mineralization in OA tibial plateaus, displaying focal areas of sclerosis that overlapped macroscopically with areas of cartilage damage. These data were confirmed at the histological level by a strong correlation between Mankin score and grade of sclerosis ($r = 0.7$, $p < 0.001$). Immunohistochemistry showed that $CD20^+$, but not $CD3^+$, lymphocytes and $CD68^+$ mononuclear (macrophage) and multinucleated (osteoclast) cells were present in subchondral marrow spaces. Notably, the number of $CD20^+$ lymphocytes and $CD68^+$ cells was significantly ($p < 0.05$) increased in sclerotic subchondral bone. Enhanced osteoclast activity was confirmed by a significantly increased ($p < 0.05$) number of multinucleated and mononuclear $TRAP^+$ cells in sclerotic bone. Finally, the number of $CD68^+$ cells was strongly correlated ($p < 0.001$) with Mankin score ($r = 0.7$), grade of sclerosis ($r = 0.8$), $CD20^+$ lymphocytes ($r = 0.8$), and TRAP-positive cells ($r = 0.9$).
Outgrowth cultures of subchondral bone showed cells of different morphologies including fibroblast-shaped osteoblasts and macrophage-like cells. Expression of ALP was detected in the prior, while TRAP expression was evident in the latter. Corresponding with histological analyses, the number of $TRAP^+$ cells was increased inex vivooutgrowth cultures of sclerotic compared to non-sclerotic subchondral bone.
Conclusions: Together, our data suggest that osteoimmunological mechanisms, specifically the interaction of $CD68^+$ macrophages with bone-resident cells, play a – previously unknown – role in regulating subchondral bone sclerosis in progressive OA. Targeting osteoimmunology might hold potential as a disease-modifying treatment for OA.

FM78

Histological Evaluation of SPECT-CT Imaging in End-stage Ankle Osteoarthritis

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Objective: Single photon emission computed tomography (SPECT)-CT is an emerging diagnostic imaging tool for osteoarthritis (OA). While subchondral bone sclerosis is a hallmark of end-stage OA, the cellular and molecular mechanisms of increased bone turnover in OA remain elusive. In this study, we investigated the cellular mechanisms of increased bone remodeling, defined by SPECT-CT, in patients suffering from end-stage ankle OA.
Methods: Pre-operative SPECT-CT imaging, using ^{99m}Technetium-dicarboxypropane diphosphanate (^{99m}Tc-DPD), was performed in six consecutive OA patients (mean age 63, range 52–72) undergoing total ankle replacement. AOFAS score and VAS were used for clinical evaluation in this study group. Intra-operative distal tibial and talar

resections were obtained and standardized samples (5 x 5 mm) were divided into four categories according to subchondral bone density (low or high) and ^{99m}Tc-DPD uptake (negative or positive). For histological analyses, tissue sections (10 mm) were stained with haematoxylin and eosin (H&E) and van Gieson`s stain to evaluate cellular morphology and extracellular connective tissue, respectively.
Results: Preoperative AOFAS score and VAS were 40 ± 15 (range 20–56) and 7.5 ± 0.84 (range 7–9), respectively. The spatial distribution of SPECT-CT-positive lesions was heterogeneous, with hotspots located in four tibial and two talar resections. ^{99m}Tc-DPD uptake was found exclusively in areas of increased bone density (sclerotic) as defined by CT scans, while ^{99m}Tc-DPD tracer-negative areas were both of low and high bone density. H&E staining revealed marked infiltration of subchondral marrow spaces by a fibrovascular tissue in SPECT-CT-positive regions. Bone-lining osteoblasts were specifically present in these regions, while they were absent from SPECT-CT-negative subchondral bone. Van Gieson's staining showed a massive increase of collagen deposition into randomly organized fibers, which is typical for formation of woven bone as a result of rapid osteoblast-mediated osteoid production.
Conclusion: In end-stage ankle OA, increased ^{99m}Tc-DPD tracer uptake in subchondral bone tissue corresponds with fibrovascular marrow infiltration and osteoblast-mediated woven bone formation. These findings indicate that extensive subchondral bone remodeling plays an important role in the development and progression of OA in SPECT-CT positive areas of the ankle.

FM79

A comparative study of growth factor release from L-PRF and L-PRP and their effect on migration of mesenchymal stem cells and endothelial cells

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Objective: The aim of this in vitro study was to investigate the release of growth factors from L-PRP and L-PRF during 28 days of culture and their influence on the migration of MSC and endothelial cells, two cell types with an important role in the healing process.
Study design: Blood samples were collected from 11 young healthy male volunteers, and L-PRP and L-PRF were prepared using standard protocols. Platelet-rich concentrates were placed in culture media and incubated at 37 °C in CO_2 incubator for 28 days. Media was collected with new media addition after 8h, 1, 3, 7, 14 and 28 days. The levels of vascular endothelial growth factor (VEGF), platelet derived growth factor AB (PDGF), insulin-like growth factor-1 (IGF-1), transforming growth factor β1 (TGFβ1), and interleukin 1β (IL-1β) were quantified using ELISA. A cell migration assay using MSC and endothelial cells in a Boyden Chamber was performed with media samples collected at all time points.
Results: When compared to L-PRF, L-PRP released higher amounts of VEGF, PDGF, IGF-1 and TGFβ1 within the first 8 hours. In contrast, L-PRF released significantly more PDGF and IGF-1 from 1 to 3 days, significantly more VEGF and TGFβ1 from 3 to 7 days while only release of TGFβ1 was significantly increased from 7 to14 and from 14 to 28 days when compared to L-PRP. Release of VEGF and TGFβ1 from L-PRF was constant for the first 7 days, followed by a decrease until the end of the culturing period; in contrast, it peaked from 3 to 7 days from L-PRF. PDGF and IGF-1 release was continuous from L-PRF for the first 3 days, followed by a decrease, while it decreased already after 8 hours and remained low from L-PRP. IL-1β release was similarly low in both platelet concentrates.
The chemoattractants released from L-PRF within the first 8 hours, and from 1 to 3, 3 to 7 and 7 to 14 days induced significant migration of endothelial cells in comparison to L-PRP. Similarly, L-PRF chemoattractants released from 1 to 3 and 3 to 7 days resulted in a significantly higher migration of MSC compared to L-PRP.
Conclusion: The release of growth factors from the L-PRP peaked at the onset of culture, while being continuously release from L-PRF over a period of 28 days. Moreover, L-PRF demonstrated better chemoattractant properties with endothelial cells and MSC compared to L-PRP. Depending on whether a boost or a constant release of growth factors is desired for the healing process, L-PRP or L-PRF would be employed in clinics.

FM80

Gain of length – loss of strength? – Alteration in muscle strength after femoral leg lengthening with a motorized intramedullary nail

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Introduction: Intramedullary leg lengthening with a motorized nail can reduce the complications which are associated with leg lengthening by external fixation. The data on the recovery of muscle strength after leg lengthening is very limited. This prospective oberservational study was designed to investigate the alteration in muscle strength in patients with a femoral leg lengthening with a motorized intramedullary nail.
Methods: Thirty patients with a median leg length discepancy of 3.0 cm (range 2.4–8.0 cm) underwent femoral limb-lengthening with an intramedullary motorized device. Maximum isokinetic, concentric muscle strength of the extensors and flexors of the knee as well as range of motion were measured before (n = 30) and a median of 2.0 years after the operation (n = 21). The investigated parameters were analysed for any alterations before and after the procedure.
Results: Preoperatively there was a significant difference in median isokinetic muscle strength between the shorter and the normal leg in the extensor muscles (15%, p = 0.01)). There was no significant difference in the flexors (3%). With increasing leg length discrepancy this effect also increased in the extensors. The etiology of the LLD had no effect on muscle strength. Postoperatively there remained a difference of muscle force of the extensors (22%) between the lengthened and the normal leg. There was no alteration in the flexors. There was no significant loss of muscle force in the lengthened leg.
Conclusion: There is no significant loss of muscle strength in the treated leg after the lenghtening procedure with a tendency to a loss of strength in the extensors (7%). However we think that the remaining postoperative difference of muscle strenght has no clinical significance. We infer that physical therapy should especially focus on the training of the extensors to diminish this effect.

FM81

Treatment options in tendon healing following natural growth factor expression

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Introduction: Tendon ruptures recover slowly and the healing of injuries can be devastating. Growth factors are known to influence tendon healing. However, only little is understood about growth factors in a healing tendon. Aim of this study was to investigate the influence of growth factors on tendon healing of rats following their natural expression.
Methods: The Achilles tendon of rats were transected and resutured. First the expression of bFGF, BMP-12, VEGF and TGF-b1 was assessed by immunohistochemical analysis 1 to 8 weeks after surgery. Second the maximal failure load of healed Achilles tendons was measured dependent on the external application of bFGF, TGF-b1 and BMP-12.
Results: The natural expression of bFGF, BMP-12 and VEGF was highest 1 week after transection. VEGF expression persisted during the remaining period whereas bFGF and BMP-12 declined. TGF-b1 expression peaked again after 8 weeks. A combined application of bFGF, TGF-b1 and BMP-12 resulted in a 4fold greater load to failure after 1 week, whereas a sequential treatment of these growth factors increased the load to failure even 5.5fold.
Conclusion: During tendon healing, bFGF, BMP-12, VEGF and TGF-b1 are differentially expressed. Additional administration of growth factors can improve the load to failure in the early healing phase of rat Achilles tendons.

FM82

Nociception of Pain in Osteoarthritis May Be Triggered Through Intraosseous Nerve Fibers

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Background: The mechanism causing pain in osteoarthritis is not well understood. A connection between the presence of intraosseous sensory nerves and pain in osteoarthritis has not yet been established. We hypothesized, that in patients with severe joint pain and radiographically isolated, focal osteoarthritic cartilage degeneration, the source of pain may be exclusively localized within the subchondral bone.
Methods: This retrospective analysis includes five patients with isolated patellofemoral osteoarthritis confirmed by X-ray and MRI, with typical pain provocation upon compression of the patella against the femur. During a diagnostic knee arthroscopy two (lateral and medial) temporary intraosseous catheters were inserted under fluoroscopy into

the patella through drill holes from anteroinferiorly. On the first postoperative day both catheters were sequentially injected with 0.5 ml NaCl followed with up to 5ml of local anesthetic (ropivacain 0.5%). Pain (Visual Analog Scale = VAS 1-10) at rest and with patella compression before, during and after infiltration was documented.
Results: During instillation through the medial and lateral catheter into bone, the pain at rest shortly bursts from a mean of VAS 1.7 (range 0 to 4) to 8.3 (range 7 to 10) and 5.4 (range 0 to 10), respectively being very similar to the pain the patients had during previous axial patella compression. Pain upon patellar compression decreased from 5.5 (range 3 to 8) to 1.2 (range 0 to 3). Pain during ambulation decreased 100% in 3 patients, 75% in two patients and 50% in one patient during the effect of local anesthesia intraosseously.
Conclusion: The instillation of liquid volume (0.5 ml saline) into bone provokes a short burst of severe pain, which resembles the pain felt preoperatively and the intraosseous local anesthetic did eliminate all pain upon patellar compression and was associated with a pain relief during ambulation. Therefore, we conclude that osteoarthritic pain may at least in part be sensed and transmitted through intraosseous nerves. The mechanism of pain triggering is most likely not a direct provocation of nerve endings but elicited through an increase of intraosseous pressure, either through deformation of bone or through inflow of joint fluid. These new findings may allow to explore new surgical or pharmacological approaches to understand, diagnose or treat osteoarthritic pain.

FM83

Does the Gamma 3 need to be distally locked for stable intertrochanteric fracture? A Finite Element Analysis

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Introduction: We could observe sometime a lack of the distal locking for gamma 3 short nail. This fact is mainly due to technical error. Nevertheless, some stable fracture heals without any displacement or complication. The aim of our study is to simulate such cases based on finite element analysis
Method: A finite element analysis was carried out to study implant behavior in cases of stable intertrochanteric fractures. A digital model of femur (Digital 3D Femur, ref. Sawbone 3908) corresponding to the medium left composite 4th generation Sawbone was used. Geometries of femur and implant are discretized in Abaqus software. A vertical load of 3000 N is progressively applied to the femoral head through a ball joint. Elastic behaviour laws are implemented for cortical bone (E = 16.35 GPa, v = 0.26), trabecular bone (E = 0.155 GPa et v = 0.3) and stainless steel implant (E = 200 GPa, v = 0.3). Stress distributions in bone and implant are calculated. Interfragmentary motions are described by normal an tangential components.
Result: The simulation demonstrates that the nail does not move longitudinally during vertical load corresponding to a full bearing step. The forces are transmitted to the fracture manly through the cephalic screw. They are no traction or distraction on the distal locking screw.
Conclusion: This study demonstrates that the distal screw has probably no mechanical effect for stable intertrochanteric fracture treated by intramedullary short nail. Few clinical cases corresponding to such technical mistakes seem to confirm this fact. One could ask if such "technical mistake" could lead to change our procedure.

FM84

Proximal femoral fractures: a new concept of implant, stress and interfragmentary compression analysis

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Introduction: This paper concerns a new concept of implant for fixing proximal femoral fractures. The solution lies in the adaptability of the implant to different morphologies. The implant has intramedullary and extramedullary parts. These elements are linked with a thin curved blade, allowing the deformation of the implant during insertion. An external device allows the adjustment of the relative position of these two parts leading to a possible adjustment of the angular orientation of the cephalic screw ranging from 115° to 135°. The support points of the cephalic screw on the two rigid parts are spaced apart, thereby limiting stress in implant. Moreover, the blade partially protects the greater trochanter and maintains the gluteus medius muscles.
Method: A finite element analysis was carried out to study implant behaviour in cases of stable intertrochanteric and unstable reverse obliquity fractures. A digital model of femur (Digital 3D Femur, ref. 3908) corresponding to the medium left composite Sawbone is used in this study. Geometries of femur and implant are discretized in Abaqus software. A vertical load of 3000 N is progressively applied to the femoral head through a ball joint. Elastic behaviour laws are implemented for cortical bone (E = 16.35 GPa, ν = 0.26), trabecular bone (E = 0.155 GPa, ν = 0.3) and stainless steel implant (E = 200 GPa, ν = 0.3).
Results: Stress distributions in bone and implant are calculated. Interfragmentary motions are described by normal and tangential components. Stresses in the new implant are of lower values (400 MPa) compared to yield stress material (800 MPa). Data are finally compared to those obtained by the numerical analysis of intramedullary nail and compression hip screw (similar to Gamma nail and DHS). Results show that the new implant is more suitable in terms of stress state. Data show a decrease of relative motions of fracture lips in the case of fractured femur fitted with the new implant regardless of fracture type.
Conclusion: A new implant for treating proximal femoral fractures is proposed in this study. The angulation of the cephalic screw can be ajusted by the surgeon according to the patient's anatomy. No part of the femur is completely stiffened allowing the bone to follow its natural development. This type of implant could significantly reduce implants stocks in hospitals.

FM85

Impact of a Co-managed Hip Fracture Program on Treatment Process and Patient's Outcome. A Prospective Quality Assurance Survey

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Objective: Dedicated hip fracture programs are increasingly implemented because of the impact of these fractures. Our objective was to quantify the impact of such a program in multiple dimensions and on different time scales by comparing it with usual care.
Design: Prospective longitudinal cohort quality assurance survey with two observation periods.
Patients: Included were hip fracture patients aged 65 years or older who were treated by our trauma service because of a hip fracture. The first "Usual care" group covers 272 patients who were admitted prior to the start of the hip fracture program. The second "co-managed" group covers 229 patients admitted subsequent to full implementation of the program.
Variables: Quality of treatment process was measured: Time to surgery, length of hospital stay, completeness of documentation. Patient's outcomes were measured: Mortality rates (in-hospital, 30-days, and 1-year), readmission rates (30-days and 1-year) as well as long-term change from prefracture baseline in ambulatory- or residential status. Short-term data were acquired in person. Long-term follow up data were captured by means of telephone interview.
Results: We did not find statistical significant difference in basic data (age, gender distribution, frequency of fracture type, cognitive status), or prefracture ambulatory status between the two groups. Patients included in the second, co-managed sample were less likely to reside in the community (64% versus 70%), suffered from more preexisting comorbidities (CCI 2.5 versus 2.1; p = 0.029), were more dependent when performing ADL (49% versus 27%; p <0.001), and finally suffered from a significantly higher 1-year mortality rate (30.6% versus 20.9%; p <0.01).
The results obtained are conflicting: Length of stay was statistically significant shorter in the co-managed group (12.3 days versus 9.6 days; P <.001). There were non-significant trends towards increased "Time to surgery", and towards increased 30-day-readmission rate (9/272 versus 16/229; P = 0.09) in the co-managed group. There were no significant differences between the two groups concerning in-hospital or 30-days mortality rates or 1-year readmission rates. We did not find significant differences in the frequency of change in ambulatory status or in residential status.
Conclusions: Despite of our efforts to create two equal groups we have to conclude that patients covered by the second sample were somewhat frailer than those covered by the first sample. The co-managed hip fracture program allowed decreased length of stay without adversely affecting long-term patient's outcomes. The interdisciplinary care provided with the program did not alter patient's short-term outcomes.

FM86

In Situ Fixation and Arthroscopic Osteochondroplasty for mild Slipped Capital Femoral Epiphysis: Can the α-angle be normalized?

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Introduction: In situ fixation of mild (epiphyseal–shaft angle <30°) slipped capital femoral epiphysis (SCFE) is a well accepted treatment method. However, the remaining retrotilt morphology represents a CAM type deformity suspected to favour early osteoarthritis by femoroacetabular impingement. Arthroscopic osteochondroplasty during in situ fixation could overcome this disadvantage with limited additional invasiveness. The aim of the present study was to test the hypothesis that α-angles could be improved to normal by arthroscopic osteochondroplasty in addition to in situ fixation. An α-angle [1] less than 55° was considered normal.
Methods: Between April 2010 and November 2011, nine patients (6 female, 3 male; range 10–15y; BMI 17–32 kg/m^2) presented with mild SCFE (mean epiphyseal-shaft angle 26 ± 5°) and received arthroscopic osteochondroplasty in addition to in situ fixation. Two plane x-rays and native hip MRI including radially reformatted images were available pre- and postoperatively in all patients. α-angles were measured on radially reformatted images in the anterosuperior section pre and postoperatively by two independent raters.
Results: α-angles improved from 57.6° (range 45–74°, SD 8.6) to 38.2° (range 30–51°, SD 7.1). No complications were encountered.
Conclusion: Hip arthroscopy in addition to in situ fixation can restore physiological α-angle in mild SCFE.

FM87

Joint Degeneration Pattern in Severe Pincer Impingement and its Implications for Surgical Therapy

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Introduction: Severe pincer impingement (acetabular protrusio) is an established cause of hip pain and osteoarthritis. The pain is considered to be due to an early dynamic pathological contact of the excessive acetabular rim with the femoral head-neck junction. However, according to the literature, the radiographic joint degeneration in severe pincer impingement typically occurs in the superomedial aspect of the hip sourcil, which is not explained by the femoroacetabular impingement concept. We therefore asked the following questions: (1) is there a static overload in the medial aspect of the protrusio joint? (2) Does acetabular rim trimming lead to an increased static overload in protrusio hips?
Methods: Four hip morphologies derived from patient data were analyzed using three-dimensional finite element models: normal, dysplasia, acetabular protrusio and acetabular protrusio with rim trimming. In vivo force and motion data for walking and standing to sitting were applied to calculate contact pressures, von Mises stresses and femoral head migration.
Results: In protrusio hips, we found a static overload at the medial margin of the lunate surface, which was amplified by an additional medialization of the femoral head leading to eccentric loading. The calculated von Mises stress was up to 54% higher in comparison to normal hips. Acetabular rim trimming in a protrusio hip even increased the static overload at the medial aspect of the lunate surface up to 28%. During walking, the dysplastic configuration, compared with protrusio, resulted in opposite patterns of stress and contact pressure having its peak values located at the anterolateral acetabular rim.
Conclusion: The findings substantiate the hypothesis that severe pincer impingement (protrusio) represents a unique pathology which involves a dynamic impingement problem at the lateral edge of the acetabulum, and – similar to a "medial dysplasia" – a static overload at the medial edge of the acetabular lunate surface. Based on these findings, the curative joint-preserving treatment of this pathomorphology would consist of a reorientation of the acetabulum rather than isolated rim trimming alone.

FM88

Sports and activity levels after open treatment of femoroacetabular impingement

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Introduction: Studies involving professional and semi-professional athletes indicate that surgical treatment of symptomatic femoroacetabular impingement (FAI) is highly successful in terms of return-to-sports and satisfaction, irrespective of the surgical approach used [1–4]. In contrast to these results achieved in highly selected patients, only little is known about the sports behaviour and activity levels after surgical FAI treatment of the more typical young recreational athlete.
Methods: This retrospective study included 153 patients (mean age 30 years, 40.5% females) with 192 hips treated. Sports behavior and satisfaction were determined at a mean follow-up of 59.4 months after surgical hip dislocation using a questionnaire. Activity levels were assessed by the Hip Sports Activity Scale (HSAS) and the UCLA activity scale.
Results: Of 126 patients being regularly sports-active before surgery, 107 (85%) were so at follow-up. Nineteen patients (12%) stopped participating in regular sports and eight (5%) commenced with sports after the operation. The most popular activities before surgery were skiing (22%), cycling (22%), jogging (20%) and soccer (13%). At follow-up, most patients were engaged in cycling (23%), fitness-/weight-training (20%), skiing (18%), and jogging (11%). Of all patients, 75% were satisfied with their sports ability and 60% stated that their sports ability had improved after surgery. Mean pain levels during sports were 2.1 according to the VAS. Mean HSAS (range from 0–8) and UCLA (range from 1–10) levels were 3.5 and 7.7 whereby males reported significantly higher levels than females (4.1 versus 2.7 and 8.2 versus 7.0, respectively).
Conclusion: The present data show that the vast majority of FAI patients treated by surgical hip dislocation can return to sport activities and that most patients are subjectively satisfied with their sports ability at a mid-term follow-up. Activity levels as assessed by the HSAS and the UCLA are significantly higher in male patients but this does not yield in higher satisfaction rates. Differing and overly optimistic expectations might explain this observation, indicating that sport expectations need to be comprehensively discussed and possibly adjusted to a reasonable level before surgery.

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FM89

Effect of CCD-angle on impingement free hip range of motion

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Introduction: Several aberrations of hip morphology can reduce hip range of motion (ROM) by femoroacetabular impingement (FAI). Among them asphericity of the head-neck junction and regional or global acetabular overcoverage are extensively discussed in the literature. Other aberrations such as valgus and varus deformities of the proximal femur are not.
The aim of the study was to explore the effect of varying centrum-collum-diaphyseal angles (CCD) on impingement free ROM.
Methods: A CAD-based 3D simulation model of the hip was installed to gradually deform the femur to create CCD-angles from 90–160°. To improve estimates of normal ROM two additional hip models based on MRI pictures of a volunteer were used. FAI was defined as bone to bone contact within physiological hip ROM defined from literature.
Results: With decreasing CCD angles of less than 110°, range of abduction and internal rotation at 90° of flexion were reduced and led to FAI. No impingement was seen with flexion and extension. With increasing CCD angles, the range of adduction and extension got reduced and resulted in FAI for adduction and extension at 135° and 145°, respectively. No impingement was seen with external rotation at 90° of flexion. Zones of impingement on the acetabular side were located at the superior rim with coxa vara and at the posteroinferior rim with coxa valga. Acetabular rim trimming could not compensate for CCD angles outside the range of 110–135° since combined movements remained impinged. Zones of impingement on the femoral side were found to be distal to the head neck junction at the mid-cervical region showing the smallest cross sectional area.
Conclusion: In the investigate model, variations of the CCD angle shows a marked influence on impingement free hip ROM. Outside CCD angles of 110–135° FAI occurs. Typical rim trimming and/or neck osteochondroplasty does not allow for adequate bony correction to solve FAI.

FM90

Proportions of Iliocapsularis and Rectus Femoris Muscle Predict DDH

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Introduction: The iliocapsularis muscle is a little known, but uniformly present muscle of the hip. It originates from the anteromedial hip capsule and anterior-inferior iliac spine. Its insertion is located just distal to the lesser trochanter. The iliocapsularis muscle has a postulated function as a hip stabilizer. In a previously MR-based study a hypertrophied iliocapsularis was found in developmental dysplasia of the hip (DDH). Therefore, we asked whether the proportions of the iliocapsularis muscle in relation to the recuts femoris muscle predict a deficient acetabular coverage (DDH)?
Patients and Methods: The anatomical dimensions of the iliocapsularis and rectus femoris muscle were compared between 45 hips with DDH (Group I) and 40 hips with excessive acetabular coverage (Group II). DDH (Group I) was defined as an LCE angle of less than 25° with a minimal acetabular index of 14° on anteroposterior AP pelvic radiographs. Group II with excessive acetabular coverage was defined as and LCE angle exceeding 39°. The anatomical dimensions of both muscles were evaluated in axial arthro-MRI slices at the height of the femoral head using the following parameters: thickness, width, circumference, and cross-sectional area (CSA). For all four parameters ratios were calculated comparing the iliocapsularis values with the rectus femoris values. We calculated positive and negative predictive values using receiver operating characteristic (ROC) curves for each parameter used to diagnose DDH.
Results: The iliocapsularis to rectus femoris ratio was increased for thickness, width, circumference, and CSA. At a one-to-one ratio all parameters had a high positive predictive value ranging from 77 to 89%. From all four parameters the highest positive predictive value had the CSA with 89% (95% confidence interval, 74–97%).
Conclusion: The anatomic dimensions of the iliocapsularis muscle in comparison to the rectus femoris muscle are associated with acetabular morphology. All parameters are indicators for DDH with the CSA having the highest positive predictive value. These results suggest that the iliocapsularis muscle is a stabilizer of the hip. Additionally, preoperative evaluation of this muscle can be used as an adjunct for decision making when treating patients with borderline DDH.

FM91

Hip Range of Motion in Everyday Life

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Introduction: To date, there is no clear consensus as to the amplitude of movement of the "normal hip". Knowing the necessary joint mobility for everyday life is also important to understand different pathologies and to better plan their treatments (correct implant positioning in total hip arthroplasty, define amount of bone resection in the treatment of femoroacetabular impingement, planning of reorientation osteotomies, etc.). To address these questions, we performed a preliminary study that aims at defining in a precise way the necessary hip joint mobility for everyday tasks based on the coupling of MR imaging and optical motion capture.
Methods: Motion capture and MRI was carried out on 4 healthy volunteers (mean age, 28 years). A morphological analysis (alpha angle, acetabular depth and version, etc.) was performed to assess any bony abnormalities. Motion from the subjects were acquired during routine activities (stand-to-sit, lie down, lace the shoes while seated, pick an object on the floor while seated or standing) known to be painful or prone to implant failure (dislocation, impingements). The hip joint kinematics was computed from the recorded markers trajectories using a validated optimized fitting algorithm which accounted for skin motion artifacts(accuracy: translational error ≈0.5 mm, rotational error <3°). The resulting computed motions were applied to patient-specific hip joint 3D models reconstructed from their MRI data.
The hip range of motion was quantified for each subject and for all motions, thanks to two bone coordinate systems (1 for the femur and 1 for the pelvis). Given the computed bone poses from motion capture data, hip angles were determined at each point of the motion, independently of the major anatomical planes.
Results: According to the morphological analysis, all subject's hips were normal. For all movements, a minimum of 95° hip flexion was required (mean range 95°–107°), lacing the shoes and lying down being the more demanding. Abduction/adduction and IR/ER remained low (± 20°) and variable across subjects.
Conclusion: As shown in this study, daily activities of a "normal hip" involve intensive hip flexion, which could explain why such motion can yield hip pain or possible implant failure. This information should be considered by orthopedists and implant manufacturers in the surgical planning and prosthesis design when restoring patient mobility and stability.

FM92

Accuracy Assessment of Hip Clinical Exam

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Introduction: Determining the hip range of motion (ROM) is one of the key points of its clinical examination. Unfortunately this process may lack precision since during hip movement there might be motion of other joints around the pelvis. It is also unknown if the examiner's clinical experience plays a role. We present the results of a preliminary study that aims to assess the accuracy of the hip ROM clinical exam executed by different examiners.
Methods: 2 healthy volunteers (26 and 31 years) participated to the study. A hip clinical exam was performed successively by 2 orthopedists (2 and 12 years' experience), while the motion of the subjects was simultaneously recorded using optical motion capture. The following sequences were captured: 1) supine: maximal flexion, maximal IR/ER with hip flexed 90°, maximal abduction; 2) seated: maximal IR/ER with hip and knee flexed 90°. For all measurements, a hand held goniometer was used by clinicians to measure hip angles in those different positions.
Their results were compared to the internal hip joint kinematics computed from the recorded markers trajectories using a validated optimized fitting algorithm which accounted for skin motion artifacts (accuracy: translational error ≈0.5 mm, rotational error <3°). The resulting computed motions were applied to patient-specific hip joint 3D models reconstructed from their MRI data. Given the computed bone poses from motion capture data, hip angles were determined at each point of the motion independently of the major anatomical planes, thanks to two bone coordinate systems (1 for the femur and 1 for the pelvis).
Results: The error made by the clinicians varied in the range of ± 10°, except for the flexion and abduction where the error was higher (flexion: mean 9.5°, range –7°–22°; abduction: mean 19.5°, range: 8–32°). No significant differences between the errors made by the two examiners were noted (mean error for each examiner: 7.4° vs 8.4°). 3D simulations of the process revealed interesting motion trends of other joints around the hip that could explain overestimation of flexion and abduction during the exams.
Conclusion: To our knowledge this is the first study of this kind assessing the accuracy of the hip clinical exam. The results seem to indicate that the clinical exam is a precise method for determining hip passive motion, if extra care is taken to stabilize the pelvis during flexion and abduction to prevent overestimation of the ROM. The examiner's experience was not found to be a determining factor. Further studies including more subjects are required before validating the values of hip clinical exam as a gold standard.

FM93

Validity, reproducibility and responsiveness of the Oxford Hip Score in patients with femoroacetabular impingement

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Introduction: With the gradual acceptance of femoroacetabular impingement (FAI) as a disease mechanism of the hip, the scientific interest in the syndrome has increased and it has been described more frequently in the literature. The use of patient-reported outcome measures (PROMs)in the assessment of treatment success is now commonplace. However, with the exception of the Hip Outcome Score (HOS), the hip-specific PROMs used in previous studies on FAI patients or in patients with other hip disorders have been not externally validated for use in FAI patients. One such instrument is the Oxford Hip Score (OHS). The OHS is quick and easy to complete. It was developed to assess patients with total hip arthroplasty (THA), in terms of their pain, mobility and function due to their hip problem. The aim of this study was to examine whether the psychometric properties (validity, reproducibility and responsiveness) of the OHS were acceptable enough to extend its use to patients with FAI.
Methods: 165 consecutive patients with FAI undergoing either arthroscopic surgery with labral preservation or limited anterolateral open surgery with labral resection completed the OHS and HOS before the operation. Six and 12 months postoperatively they were asked to complete the questionnaires again. 126 (76%) patients returned completed questionnaires at all three time-points. Over the

same period, 613 consecutive patients undergoing THA completed the OHS at baseline, and 550 (89%), at all three time-points At 6 and 12 months' follow-up, the patients also rated the global treatment outcome ("how much did the operation help your hip problem?") on a 5-point Likert-scale with responses ranging from "helped a lot" to "made things worse."
Results: The reproducibility of OHS was good and was similar for both the THA and FAI groups (SEM of 5.6% for THA and 6.2% for FAI, and ICC 0.97 for both FAI and THA). The responsiveness (Cohen's d) of the HOS in FAI patients was high and similar to the HOS (d from 1.32 to 1.61 for the OHS and from 0.99 to 1.64 for the HOS). The correlation coefficients between HOS subscales (activity of daily living and sport) and OHS were large (r = 0.67 to 0.85). Similarly, high correlations were found between the changes scores of the two instruments (r = 0.60 to 0.76) and between changes scores and the transition question (r = 0.52 to 0.59). In the FAI patients, floor and ceiling effects ranged from 0 to 7.6% for OHS and from 0 to 16.8% for HOS.
Conclusions: The OHS showed sufficiently good psychometric attributes to support its use in FAI patients. When compared with the HOS (an instrument specifically developed for FAI patients), the measurement properties were similar. In conclusion, the study showed that the OHS, although originally developed for patients undergoing THA, can also be used for assessing pain and function in FAI patients.

FM94

Oblique 'Bikini' Incision for Anterior Approach Total Hip Arthroplasty: Technique and Preliminary Results

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Background: The direct anterior approach for total hip arthroplasty uses an internervous plane without muscle detachment from bone. However, the classic longitudinal skin incision does not follow the anatomic skin creases and can result in scar widening and subjective discomfort. We therefore modified our incision technique to a short oblique skin incision following the anatomic skin crease of the groin.
Purposes: We sought to determine whether (1) the oblique incision leads to improved subjective and objective scar results compared with the longitudinal incision, (2) functional and pain scores are similar between the two approaches, and (3) the new incision is safe with respect to complications, blood loss, implant position, and lateral femoral cutaneous nerve (LFCN) symptoms.
Methods: Fifty-nine patients underwent total hip arthroplasty using either the classic (n = 33) or the new oblique incision (n = 26). At six months after surgery, we compared objective and subjective scar results, WOMAC, Oxford Hip and UCLA scores, blood loss during operation, cup inclination, and the presence of LFCN symptoms between both groups.
Results: Objectively, the modified incision resulted in significantly shorter and narrower scars. Subjectively, patients in the modified incision group were substantially more satisfied with the aesthetic appearance. Functional and pain scores did not differ between the groups. No complications occurred in either group. Blood loss and cup inclination were similar. There were no differences in the presence of LFCN symptoms.
Conclusions: In this preliminary series, the 'bikini' incision for an anterior approach THA led to improved scar cosmesis and was found to be safe in terms of blood loss, appropriate component placement, and risk for LFCN injury

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FM95

Limitations of the Vastus Lateralis Muscle as a Substitute for Lost Abductor Muscle Function: A cadaver study

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Introduction: The vastus lateralis muscle (VL) is widely used as a muscle flap in plastic surgery. The VL was first described as a functional flap for the treatment of hip abductor discontinuity in 2004. The transfer of the VL is difficult because it is innervated in a two-fold manner with shorter proximal and longer distal nerve branches. When seeking to determine whether, and to what extent, the VL can be transferred, the short nerve branches are the limiting factor. The aim of the present study was to investigate the innervation of the VL and adjacent muscles with special emphasis on the proximal shift of the VL.
Methods: Twelve cadaveric hemipelvises with legs from eight specimens were investigated. All nerve branches to the VL and vastus intermedius (VI) were carefully dissected. The length of all nerve branches and the angles of the proximal nerve branches to the VL, in relation to the longitudinal axis of the femur, were measured. The nerves were then traced intramuscularly in their distal course, and their dividing pattern was studied.
Results: The shortest proximal branches, which were two to four in number, had a mean length of 3.6 cm (range, 1.9 to 5.0 cm). The short muscle branches to the VL coursed at a mean angle of 50.1 degrees (range, 30 to 70 degrees) in an anteroposterior (AP) direction and at a mean angle of 47.9 degrees (range, 35 to 65 degrees) in a mediolateral (ML) direction. Based on this data, the potential proximal shift of the VL was calculated: 4.6 cm (range, 2.1 to 6.9 cm) in the AP- and 4.7 cm (range 1.3 to 7.5 cm) in the ML-direction. The length of the distal nerve branches were, on average, 11.3 cm (range, 7.8 to 16.1 cm). The short muscle branches to the VL ramified before they entered the muscle and side twigs supplied various portions of the VL and VI. Nerve branches that primarily supplied the VL ran as terminal branches to lateral portions of the VI and vice versa.
Conclusion: When harvesting and shifting the VL as a functional flap, one must protect its innervation. This is not possible. Firstly, the VL shift inevitably damages side branches to the VL and the VI. The same is true for nerve branches in the deeper aspect, running crosswise between the VL and the VI. Secondly, direct muscle branches to proximal portions of the VL are too short to allow a significant shift.

FM96

Intraoperative monitoring of periacetabular osteotomy using 3-D custom made cutting and repositioning guides: a cadaver study

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Introduction: The goal of periacetabular osteotomy (PAO) is to reorient the acetabulum in a more physiological position. Its realization is challenging because 1) osteotomy planes should keep the pelvic ring intact while staying extra-articular and 2) the final position of the acetabular fragment lies within a narrow three-dimensional range. Assistance with custom cutting- and reorientation-guides would thus be very helpful and save intraoperative x-ray time. Our purpose is to present a pilot study on such guides.
Methods: 8 cadaveric (6 female and 2 male) hemipelvis, (mean age 85,25 years, range 56–100) were scanned using Siemens CT with voxel size 0.65*0.65*1.25 mm. After segmentation of the images using Mimics® software, 3D models of each specimen were created. A PAO was virtually performed on the 3D models and reorientation of the acetabulum was defined. Using 3-matic® software, an anatomy-specific guide was designed aimed to assist in iliac, posterior column and superior pubic ramus cuts as well as in acetabulum reorientation. Also position and length of fixation screws were planned. Regarding guidance and fixation of reposition 2 concepts of custom made guides were developed. Concept 1 was tested on 6 cadavers and concept 2 on two cadavers Laser-sintered guides were used to perform PAO on respective specimens. PAO was performed using original instruments by two surgeons (one experienced, one novice). CT images were acquired postoperatively. Preoperative, postoperative and virtually planned acetabulum reorientation were compared.
Results: Application of the guides through the standard modified Smith Peterson approach and performance of the osteotomies, reorientation and fixation went uneventfully. Two cadavers showed very low bone quality with insufficient stability of fixation and were excluded from further analysis. The postoperative analyses showed that the cutting planes were completely extra-articular and the posterior column intact in all 8 specimens. Correlation between planning and postoperative result in terms of the acetabular index (AC), centre edge angle (CE), acetabular anteversion angle (AcetAV) and the position of centre of rotation (COR) revealed following differences:
COR preoperatively compared to postoperatively showed a deviation of 7.20 mm (stdev 1.86 mm) on all performed PAOs (n = 6). Deviation of COR of concept 1 (n = 4) showed 7.82 mm (stdev = 2.04). Deviation of COR concept 2 (n = 2) showed 5.96 mm (stdev = 0.49).
Both concepts (n = 6) showed differences from of the CE angle of 5.78° (stdev 4.04°), AC angle of 5.11° (stdev 3.27°), AcetAV angle of 14.98° (stdev 11.09°).
Concept 1 (n = 4) showed differences from of the CE angle of 4.61° (stdev 4.49°), AC angle of 3.98° (stdev 3.56°), AcetAV angle of 13.61° (stdev 9.66°).
Concept 2 (n = 2) showed differences from of the CE angle of 8.13° (stdev 2.16°), AC angle of 7.38° (stdev 0.36°), AcetAV angle of 17.72° (stdev 17.66°).
Conclusion: The use of 3D guides was possible through a standard approach without extension and revealed reliable fit of the guides to bone, reliable positioning of the osteotomies and planned corrections.

FM97

Positioning of sacroiliac screws using an intraoperative 3D CT (O-Arm©) guided navigation in posterior pelvic ring fractures

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Objective: Sacro-iliac (SI) screw fixation for sacroiliac joint disruption and fractures of the sacrum is an accepted method of treatment. Aberrant screw or wire placement can lead to significant complications, including injury to the fifth lumbar nerve root, sacral venous plexus, iliac vessels, or cauda equina. Incorrect positioning of the SI-screws has been reported in up to 16% and in 7% this lead to neurovascular complications. In order to avoid such complications some authors suggest an intraoperative 3D CT guided navigation for screw positioning. We report our experience in the use of an intraoperative 3D CT guided navigation for the positioning of SI screws using the mobile O-Arm scanner.
Methods: From August 2008 to December 2012, we performed 23 O-ArmÓ navigated SI-transfixations in 20 patients. Indications were unstable posterior ring fractures and painful SI-joint disruption. The operations were performed either in a prone position, when solely a dorsal fixation was performed, or supine, when associated with anterior pelvic ring stabilization. The reference pin was positioned for navigation purpose. A first O-Arm scan of the pelvis was performed for planning. Using this scan, 1 or 2 percutaneous 6 to 8 mm diameter screws were inserted using the Medtronic© navigation system. A final scan was then performed for screw position control.
Results: 16 patients were male, 4 were female. Median age was 45.5 (18–84). 3 patients were operated bilaterally, 7 underwent an exclusive SI-transfixation. 13 also had an anterior pelvic ring or acetabulum osteosynthesis. 6 were SI joint disruptions, 16 were sacrum fractures and 1 was combined. The second intraoperative control scan showed that all screws were correctly positioned. The patients showed no intraoperative or postoperative complications.
Discussion: In our experience, navigation guided SI screw positioning using the O-Arm scanner is a safe method, that enables correct screw placement and a low radiation dose for the operator. The advantages of the O-Arm compared to other devices are its mobility that allows intraoperative use and the image quality, which is comparable to standard CT-scan. Advantages of a mobile CT imaging combined with navigation inside the OR are lack of radiation for the surgeon and the staff, the lack of patient transport and the precision and reproducibility of the screw positioning. The downside is the high acquisition cost.

FM98

Mid-term outcome following fixation of anterior pelvic ring injuries using the modified Stoppa approach

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Introduction: The modified Stoppa approach was introduced for less invasive open reduction and internal fixation of anterior pelvic ring injuries. The aim was to describe the outcome with focus on the elderly after treatment of pelvic ring injuries using this approach.
Methods: A consecutive series of 46 patients (50 yrs, 19-79; 27/46 C-type fractures) treated operatively using the modified Stoppa approach between 07/2004 and 08/2011 was assessed in accordance to age (group A: "<60 yrs" (n = 33), group B: "≥60 yrs" (n = 13)). Surgical data, accuracy of reduction according to the Rommens criteria and at a mean follow up of 33 months (12–95) the need for revision, union rates, the functional outcome using the Majeed-Scoring and Oswestry Disability Questionnaire and the occurrence of chronic pelvic pain by the Mainz Pain Staging System were assessed.
Results: In most cases (43 of 46, 94%) anatomic or nearly anatomic reduction was achieved. All fractures consolidated. In 3 of 46 (7%) patients intraoperative complications were noted, in 4 of 46 (9%) patients revision surgery was necessary due to failure at the anterior pelvic ring. The majority of patients presented with an "excellent" or "good" functional result (35 of 46, 76%) according to the Majeed Score and suffered from no or minor chronic pelvic pain (35 of 46, 76%). The mean rated level of impairment was 18% (0–54%) using the Oswestry Disability Questionnaire. No statistical significant differences were noted between frequencies or mean values in both age groups in any tested item.
Conclusion: The modified Stoppa approach provided adequate exposure for reduction and fixation of pelvic ring injuries. No differences in morbidity or the outcome related to age were observed so that surgical treatment with open reduction and internal fixation of the anterior pelvic ring in type B- and C- pelvic ring injuries is an adequate technique even in the elderly.

FM99

Short-term outcome after management of acetabular fractures using the Pararectus approach

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Introduction: The Pararectus approach was introduced previously as a new anterior intrapelvic approach for treatment of displaced acetabular fractures. The aim was to present the short-term outcome data after its clinical implementation.
Patients: A consecutive series of 20 patients (mean age 59 years, range: 17–90; 17 male) with displaced acetabular fractures involving predominantly the anterior column and the quadrilateral plate was treated between 12/2009 and 12/2010 using the Pararectus approach. Initially, the accuracy of reduction using CT scans and the occurrence of intraoperative complications were assessed. Enrolled in a prospective evaluation protocol, patients were evaluated 12 and 24 months postoperatively. Clinically, the Harris Hip Score, the Western Ontario McMasters (WOMAC) Score and the Merle d'Aubigné and Postel grading adapted by Matta were used. Radiographically, conventional radiographs were analyzed for occurrence of osteoarthritis (OA), heterotopic ossifications (HO) or avascular femoral head necrosis (AVN) according to Tönnis-, Brooker- and Ficat classifications respectively. Failures were defined as total hip arthroplasty, a Merle d'Aubigné score of less than 14 points, a Harris Hip Score of less than 70 points, and/or a radiographic progression of osteoarthritis (Tönnis grade 2 or 3). The clinical and radiographic outcome was rated according to Matta.
Results: Initially, the reduction was noted to be "anatomical" in 19 and "imperfect" in one patient. Minor lesions to the peritoneum were noted in two patients, minor vascular damage in a further two. All surgeries were finished uneventfully and fractures healed in all patients. During follow up, three patients were lost to follow up (two patients died eleven and 19 months after surgery, one patient was discharged overseas and lost), further three patients refused consultation 24 months postoperatively as they were doing well (two patients suffering from dementia and one elderly patient). Two patients had to be excluded from further evaluation as they required a total joint replacement four and 18 months, respectively, after the index procedure. In the further 12 patients, no failures were observed, the clinical outcome was rated according to Matta as "excellent" or "good" in seven and five patients, respectively whereas the radiographic outcome showed "excellent" results in ten cases, "good" or "fair" results in one patient in each case two years after surgery.
Conclusion: In the treatment of complex acetabular fractures in patients the Pararectus approach allowed for anatomic restoration with minimal access morbidity and provided promising outcome at the short-term. At our department in Pararectus approach has become the standard approach in the presented fracture patterns.

FM100

One stage revision of infected hip arthroplasty with and without cement

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Introduction: According to a treatment algorithm (N Engl J Med. 2004;351:1645–54) well selected patients with infected hip replacement qualify for one-stage revision. Eradication of infection is achieved by implant exchange and antibiotica administration without additional local antibiotics, thus permitting fixation without antibiotic loaded cement. The outcome of our one-stage revisions is presented.
Methods: After joint aspiration and identification of the microorganisms all patients qualifying for one-stage-exchange were included. Thorough debridement and cemented or uncemented reimplantations were performed according to the preference of the surgeon. In case of cementation Palacos® R+G was used. At least 3 additional intraoperative biopsies for bacteriological and histological analyses were sampled. Antibiotic treatment was administered intravenously for two weeks, followed by oral therapy for a total duration of 3 months. Patients had a standardized clinical and radiological follow-up.
Results: Between 1996 and 2011, 40 patients (41 hips) were treated with a one-stage procedure. In 26 cases an uncemented revision stem (Wagner or Revitan, both Zimmer®) was implanted and 38 cases received an acetabular ring (Müller or Burch Schneider). Coagulase-negative staphylococci were the most frequent pathogens (44%), followed by S. aureus (22%), streptococci (19%), and gram-negatives (10%). Polymicrobial infection was present in 4 cases. Mean follow-up was 4.7 (2.3 to 15.2) years. Three patients had died before 2 years follow-up, not related to treatment. No patient had persistence of infection or reinfection. However, there were 4 revisions for aseptic

loosening of cemented stems. The mean HHS was 81 (26 to 99) at final follow-up.
Discussion: One-stage revision of established hip infection has an excellent clinical and microbiological success rate even in fixation without antibiotica-loaded cement. A careful selection of suitable patients according to well-defined criteria and a three-month treatment with appropriate antibiotics that are active against biofilm are a prerequisite for this strategy. For correct treatment stratification an interdisciplinary approach including orthopedic surgeons and infectious diseases specialists is necessary.

FM101

Radiological short term results after total hip arthroplasty using the Fitmore® hip stem

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Introduction: The purpose of this retrospective multicenter case series was to evaluate the radiological outcome after implantation of the uncemented Fitmore® Hip Stem (Zimmer GmbH, Switzerland).
Methods: From April 2007 to December 2008, the first 145 consecutive patients (m:f = 1:1.23; median age 57.4 yrs, range 21–87 yrs) treated with the Fitmore® hip stem as part of a total hip arthroplasty (THA) were included in this study. The indication for the THA was mostly primary degenerative arthritis (n = 99), dysplasia (n = 17), but included other indications (n = 20). The typical approach used was the antero-lateral (n = 125).
Clinical and radiological controls took place postoperatively, after 6 weeks, 12 months and 24 months.
Changes to the primary position of the stem including varus/valgus as well as subsidence were measured. Furthermore, changes in the femoral bone including cortical resorption and hypertrophy, cancellous condensation or radiolucencies and signs of oscillation in the interface between stem and surrounding bone adapted to the Gruen zones were evaluated.
Results: In the first 6 weeks an increase of 0.5° to a varus position of 3.1° was detectable. An average stem subsidence of 2.4mm after 1 year with no changes in the following year is not significant.
After 1 year, 35% of all patients show some calcar resorption proximal medial on the averted side of the prosthesis (no significant changes at the direct stem-bone-inferface) and 59% show cortical hypertrophy at the level of the stem tip, mostly at the lateral side. A radiolucent line was present in 16% at the greater trochanter and in 14% at the tip.
After 2 years, bony adaptation in the calcar region can be seen in 44%. Cortical hypertrophy in the distal part of the stem is visible in 64%, but also a significant decrease of stem oscillation signs (6% at the greater trochanter; 10% at the tip) is notable.
Conclusion: The Fitmore® hip stem shows in the first 2 years a stable position in the proximal femur with a non significant subsidence of 2.4 mm and a non significant increase of varus of 0.5°. Between 1 and 2 years no further changes in position are measurable.
The changes in bony appearance will be discussed.

FM102

No regeneration potential of the human acetabular labrum after resection

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Introduction: In a previous animal model for hip joint arthritis, regeneration of the acetabular labrum was observed after resection of the antero-superior segment, without development of secondary degenerative joint disease (DJD) [1]. The biological response of the human hip joint following labrum resection is unknown. Using MRI investigations this study determined whether labral regeneration following extensive resection in humans takes place.
Methods: In a consecutive series of 800 patients operated for FAI by surgical dislocation by the senior author, 13 had undergone acetabular labral resection over an arc of at least 60° (antero-superior) due to the presence of an irreparable lesion. Nine patients (three women) were available for evaluation at an average of 3.9 ± 1.2 years following surgery. The mean age at surgery was 37.8 ± 8.8 years, the mean BMI was 25.2 ± 2.4 kg/m^2. One patient had a previous hip arthroscopy with partial labral resection. After informed consent all patients had a structured interview, an examination of the involved hip and a contrast-MRI including radial reconstructions. Extension and location of the labral lesions were recorded on a clock face from surgical records. The MRA appearance of the site of resection was then evaluated by three independent reviewers and a consensus reading was obtained. The modified Harris Hip Score (HHS), the UCLA score, the Hip Outcome Score (HOS-ADL: Activities of daily living; HOS-Sport) and the SF-12 were recorded.
Results: All but one patient were asymptomatic and none had any revision surgery or had sought further treatment prior to this evaluation. Two patients were very satisfied, 3 satisfied, 2 neither nor, 1 was dissatisfied, and 1 very dissatisfied. Surgery met the expectation in 7 patients and 6 of them would redo surgery. While looking at the site of resection, MRA did not show the presence of a structured, triangular shaped regenerate with the same signal intensity as a normal labrum. Overall, the mean HHS was 82.6 ± 14.2. The mean UCLA score was 6.0 ± 2.1. The mean HOS-ADL was 83.6 ± 15.1 and HOS-Sport was 61.2 ± 31.4. The mean SF-12 PCS was 40.1 ± 11.4 and the SF12 MCS 50.5 ± 9.0.
Conclusion: According to this series, the defect created by resection during surgery was not filled by any structured, triangular shaped tissue and hence the presence of acetabular labrum regeneration in humans seems not to be likely.
Wide acetabular labrum resection oes not seem to be a viable alternative to labral reconstruction when the lesion is too important to be repaired.

1 Miozzari HH, et al. OsteoArthritis and Cartilage 2004;12:419–30.

Free communications VIII – Hip

FM103

Dual mobility socket to prevent instability in primary total hip replacements: results at 10 years minimal follow-up

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Introduction: Total hip arthroplasty (THA) instability is well documented to be more common in specific demographic groups. We report a retrospective analysis of the use of a dual mobility implant for primary hip replacements in selected patients at risk for dislocation. The aim of this study was to assess the long-term clinical and radiologic features associated with the dual mobility cup in case of primary THA.
Materials and Methods: At our institution 119 primary THA were performed in 114 patients (74 females and 40 males) at high risk of instability between January 2000 and December 2002. 84% of the patients had at least two risk factors for dislocation. The mean age was 71 years old (range, 21.4 to 93.2 years) at the time of the arthroplasty. A dual mobility socket was used in all cases. Clinical result was assessed using Harris Hip Score, and complications were determined by detailed review of the patient's records. Radiographs of the involved joint were reviewed to assess the position of the prosthesis and to look for osteolysis and signs of loosening of the implant.
Results: During the study period, 56 patients (47%) died of unrelated causes. 17 patients (15%) were lost to follow-up. For the remaining 41 patients (46 hips, 38%), the minimal follow-up was 10 years (119 to 154 months, mean 133 months). Harris hip score improved from 39.6 to 82.4 ($p < 0.05$). Only one late dislocation was observed, 7 years after the surgery, in a 35-year old female with Mannosidosis.
Two hips were revised at latest follow-up, for deep infections. No aseptic loosening of the cup or osteolysis was observed at latest follow-up.
Conclusion: The dual mobility system was extremely successful in achieving stability in this continuous series of patients with increased risk for dislocation. In addition, no mechanical failure, and no osteolysis or aseptic loosening of the cup has been reported. The use of dual mobility cup to prevent instability in selected patients is a reliable option at long term follow-up.

FM104

Revision of unstable THA using a dual mobility socket: 3.5 to 11.1 year follow up

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Introduction: Revision procedures for unstable total hip arthroplasty have been reported with high failure rates. Many options have been proposed in such challenging cases, including dual mobility. The purpose of this retrospective study was to assess the clinical and radiologic features associated with the dual mobility cup in case of revisions for instability.
Materials and Methods: Sixty four total hip arthroplasties (62 patients) were revised for THA instability using a dual mobility cup at our institution between March 2000 and April 2008.
Mean age at reoperation was 67.3 year old (range, 35 to 98). The outcome of the revision procedure was assessed using the Harris Hip Score, and complications were determined by detailed review of the patient's records. Anteroposterior and lateral radiographs of the involved joint were reviewed to assess the position of the prosthesis and to look for osteolysis and signs of loosening of the implant.
Results: Mean follow-up was 7.5 years (range, 3.5 to 11.1). At last review 11 patients had died and one was lost to follow up. Postoperatively there was a significant improvement of the Harris Hip Score. Sixty-three patients (98.4%) had no further episodes of dislocation. There were 3 revisions for deep infection, and 4 for mechanical failures including 2 dissociation of the bipolar component, one head-trunion dissociation, and one aseptic loosening of the acetabular construct. For the remaining patients, no radiolucent lines around the components and no osteolysis were observed at latest follow up.
Conclusion: The dual mobility cup is a highly effective option to manage unstable total hip arthroplasty. Unlike constrained devices, such implants provide encouraging radiologic results regarding the potential for loosening and osteolysis at mid- to long-term.

FM105

Constrained implants for total hip arthroplasty instability: analysis of failures

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Introduction: Recurrent instability after total hip arthroplasty remains a serious and somewhat frequent problem. Constrained implants have proven effective to manage instability. This has led to a liberal utilization of these devices. However, sporadic mechanical failures have been reported. This report analyzes the failures of a single constrained device at our institution.
Materials and Methods: Forty-three constrained implants (Stryker Constrained Liner™) in 34 patients were revised out of total 390 similar implants performed at our institution. There were 24 females and 10 males. Constrained implant was inserted at the first revision in 6 hips and after an average of three surgeries (1–6) in 37 hips. Seven different methods of constrained liner fixation were observed. Eight different theoretical failure mechanisms were identified: six are mechanical device failures at each of the implant interfaces, infection and catastrophic polyethylene wear being the other two.
Results: Average time to failure was 28.4 months (1–78). Several failure mechanisms were operating in most cases. The predominant mechanism was infection in 12 (28%), type I (failure of fixation to bone) in 11 (26%), type II (failure of mechanism holding the liner to shell) in 6 (14%), type III (failure of the bipolar holding mechanism) in one (2%), type IV (dislocation of bipolar) in 9 (21%), type V (dislocation of femoral prosthetic head from bipolar) in 3 (7%), and in 1 hip we could not identify the failure mechanism; There were no instances found of type VI failure (disengagement of the prosthetic head from trunion) or catastrophic polyethylene wear.
Conclusion: Constrained tripolar implants are complex devices with multiple interfaces. We have shown multiple mechanisms of failure of these devices, and we therefore advocate restricting their use to salvage situations. As an alternative to constraining systems, dual mobility sockets have also proven effective on stability, with decreased risk for mechanical failure because of a simple design involving a limited number of parts. For these reasons, the current use of constrained implants has decreased, and the dual mobility sockets are becoming the most popular options.

FM106

Physical activity before and after primary total hip arthroplasty: a registry-based study

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Objective: Recovery of physical function is an important goal of total hip arthroplasty (THA). Detailed assessment of activity before and after THA including a long-term follow-up is lacking. Our objective was (1) to evaluate how patient's activity evolves: prior to disease onset, prior to THA, and at 5 and 10 years postoperative, and (2) to determine predictors of high activity 5 years postoperative.
Methods: We included elective primary THAs operated upon in a large University hospital between 1996 and 2012. A cross-sectional analysis compared mean UCLA activity scores over four periods: prior to onset of symptoms of osteoarthritis, prior to surgery, 5- and 10-years postoperative. Stratified analyses were performed by sex, age, BMI, ASA classes and perceived preoperative activity level. A prospective analysis was conducted to identify baseline characteristics associated with a high level of physical activity 5 years postoperative.
Results: The mean UCLA scores prior to symptom onset (N = 189), prior to THA (N = 203) and 5 (N = 1085) and 10 (N = 757) years postoperative were 6.9, 3.5, 5.7 and 5.5, respectively. UCLA scores ≥7 were reported by 49% prior to symptom onset, 5% prior to surgery, and 28% at five and ten years postoperative. Younger age, male gender, lower BMI and ASA score, and an active lifestyle prior to surgery were predictive of high physical activity 5 years after surgery.
Conclusion: Primary THA substantially and durably improved physical activity in men and women and in all age categories, but postoperative activity levels remained lower than just before the onset of OA symptoms.

FM107

Effect of cup-medialization on flexion and abduction moment arms in total hip arthroplasty

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Introduction: The classic technique of total hip replacement described by Charnley and Müller includes a medialization of the acetabular cup towards the ilioischial line with a compensatory increase of the femoral offset in order to keep the global offset anatomical. This concept is based on a 2D analysis of moment arms, which lead to the conclusion that the more medial the center of rotation is, the more favorable the moment arms. However, medialization is associated with significant bone loss. In addition, the working length of muscle fibers is altered. The purpose of this study was to compare moment arms of the hip abductors after an anatomical reconstruction with those of a reconstruction with cup medialization in a numerical 3D model of the hip during the gait cycle.
Methods: A 3D numerical model of a patient with "normal" hip anatomy was developed (using FE software Abaqus, Dassault Systèmes). The model is based on a CT scan, including the gluteus medius, minimus and maximus. A total hip prosthesis was virtually implanted with and without cup medialization (5 mm), keeping the global offset constant in both cases. Bone and prosthesis were assumed rigid, while a hyperelastic deformation law was used for the muscles. Passive flexion-extension and abduction-adduction were simulated. The range of motion corresponded to gait cycle. The gluteus medius (middle fiber) moment arm was calculated for these 2 (planar) movements separately.
Results: During flexion-extension, the minimum, average and maximum moment arms of the gluteus medius were 9.0, 10.6 and 11.2 mm without cup medialization, and 10.4, 11.7 and 12.2 mm with medialization. Respective values for abduction-adduction were 38.2, 40.5 and 41.8 mm without and 40.2, 43.1, 44.7 mm with medialization. A cup medialization of 5 mm leads to an increase of the gluteus medius moment arm of (minimal, average and maximal values) 15, 10 and 9% for flexion-extension and 5, 6 and 7% for abduction – adduction, respectively.
The change in length of the middle muscle fiber, with or without offset, was less than 1 mm.
Conclusion: A cup medialization of 5 mm resulted in an increase of 5–15% of the lever arm of the gluteus medius throughout the gait cycle, while a minimal effect on the fiber length was observed.

FM108

Micromotion, subsidence and gap at the stem-femur interface after THA: a cadaveric study

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Introduction: Excessive interfacial micromotions around the femoral stem affect the primary stability of hip implants, and may promote aseptic loosening. Physical activities such as stair climbing induce high torsional loads that are thought to endanger more the implant primary stability than compressive loads.
The aim of this study was to extend a technique based on micro computed tomography (µCT) to measure simultaneously and at multiple sites the relative interfacial micromotions and gap during compression and torsion on a cadaveric femur.
Methods: Tantalum markers were stuck on the stem (SPS, Symbios, Yverdon) while stainless steel beads were press-fitted on the endosteal bone surface of a human cadaveric femur. The cementless stem was implanted according to the technique recommended by the manufacturer. After implantation, compressive (2000 N) and torsional (13 Nm) loads were successively applied with a custom-made loading device. µCT scans were performed at 3 steps: before, during and after loading.
A custom-made image-processing algorithm was used to detect bone and stem markers from µCT images. The third unloaded µCT was used as a reference and the first two µCT were rigidly transformed so as to have the stem beads overlapping. The 3D micromotions were the difference of bone markers position between the loaded and reference µCT, while subsidence was derived from the first and last µCT. Gap was the closest distance between the bone markers and stem surface in the reference µCT.
Results: Micromotions, subsidence and gap were simultaneously measured for 384 steel beads, spread within a 40-mm region of interest. Maximum micromotions were 95 µm in compression and 170 µm in torsion. Mean subsidence was 2190 µm in compression and 630 µm in torsion. For both load cases, gap was small against the bearing faces of the implant.
Conclusion: During compression, maximal micromotions measured were below the critical value of 150 µm reported to induce aseptic loosening of the prosthesis. During torsion, local micromotions exceeded this threshold. This result underlines the importance of a simultaneous and multisite measurement of micromotions, for different load cases.
To conclude, we developed a technique to get a quasi-continuous distribution of interfacial micromotions, subsidence and gap around the femoral stem during compression and torsion. This method could be used to test implant design, surgical techniques, or validate numerical models.

FM109

One-stage bilateral total hip replacement using the direct anterior approach is safe and effective

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Background: The direct anterior approach without using a fracture table is suitable for patients who require bilateral total hip replacement (THR) and this can be performed during a single operative session. The potential benefits of single stage THR include a single episode of anesthesia, more efficient use of resources, reduced overall hospitalization and shorter rehabilitation periods. Some studies have, however, reported a higher incidence of medical and surgical complications after single stage bilateral THA compared to a staged procedure.
Purpose: The aim of this study is to determine whether single stage bilateral THA using the direct anterior approach is as safe and effective as the unilateral procedure regarding complications, radiographic assessment, and patient-reported clinical outcomes.
Patients and Methods: We retrospectively compared 14 patients who had single stage bilateral THA with a matched group of 28 patients who underwent unilateral THA with a minimum 2 years follow-up for both groups. Duration of anesthesia, operative time, blood loss, length of hospital stay, and any intraoperative or postoperative complications were recorded. Cup inclination and heterotopic ossification were analyzed on postoperative radiographs. Generic (EQ-VAS and EuroQoL-5D index) and condition-specific (Oxford Hip Score) instruments were used to assess patient-reported outcomes.
Results: No significant differences between the two groups were found for complications, radiographic assessment, or patient-reported outcomes. In the single stage THA group, blood loss, anesthesia, and operative times were less than double that of the unilateral group.
Conclusions: Single stage bilateral THA using the direct anterior approach seems to be as safe and effective as a unilateral THA, with favorable short-term clinical and radiological outcomes and similar complication rates.

FM110

Diagnosis and management of failed metal-on-metal total hip arthroplasty

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Introduction: Large head metal-on-metal (MoM) total hip arthroplasty (THA) has been considered as particularly interesting in young and active patients. This type of total hip replacement has several advantages, such as less wear, lower risk of dislocation and better range of motion. Unfortunately, revision rate is significatively higher. The purpose of this study is to review our revision cases and to define clinical, biological and radiological criteria helping us to decide if revision surgery of a large head MoM THA is necessary (flow chart). Technical and surgical aspects are discussed.
Materials and methods: Between 2005 and 2012 we implanted 352 large head MoM THA. We reviewed all patients with large head MoM THA operated in our department during this period. 17 (5%) patients with a mean age of 67 years (+/– 9) have been revised. Patients complains were noted. They all had blood test analysis (FBC, PCR, chrome/cobalt serum concentration) and standard x-ray. Sometimes CT and hip aspiration were necessary to obtain a better assessment. Anatomopathological and microbiological analysis were obtained systematically.
Results: With a mean follow-up of 5 years (+/– 2) after THA, 13 patients presented pain associated with a decreased range of motion, 2 patients a periprosthetic fracture, 1 patient with a swelling around the thigh and 1 infection. In all cases, chrome/cobalt serum level was elevated (maximum Chrome/Cobalt: 2203/2344 nm/l). No superficial signs of inflammation were reported but blood test sometimes showed increased inflammatory parameters, which needed complementary investigation by hip aspiration. On the x-ray analysis, implants were in an adequate position except in 2 cases, where the cup was too vertical (>45° of inclination). Osteolysis was rarely obvious on standard X-ray, but was uncovered by CT scan, particularly on the acetabular side. In 14 cases, revision included cup and femoral head exchange and in 3 cases cup and stem were revised. Aggressive synovitis with local invasion of muscles (gluteus medius and psoas) and metallosis were observed and confirmed by anatomopathological analysis.
Conclusion: Large head MoM THA represents a serious concern because of a high rate of revision. Pain and decreased range of motion with a high blood level of chrome/cobalt were routinely found. Revision of MoM THA involved most of the time an exchange of the cup and the femoral head. Surgery could be complicated by severe cancellous bone resorption on the acetabular side and/or lysis of tendon attachment.
Patients with large head MoM THA should be closely followed-up. In case of clinical complains, elevated Chrome/Cobalt serum concentration or radiological (standard X-rays, CT) abnormalities, early revision should be proposed.

FM111

Assessment of Congruence and Impingement of Prosthetic Hips during Everyday Tasks

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Introduction: Conventional pre-operative planning for total hip arthroplasty mostly relies on the patient anatomy for the positioning and choice of implants. This kind of planning essentially remains a static approach since dynamic aspects such as the joint kinematics are not taken into account, and is hence not able to fully consider the evolving behavior of the prosthetic joint that may lead to implant failures. In fact, kinematics plays an important role since some movement can create conflicts within the articulation and yielding possible dislocations. The goal of our study was to assess the relationship between acetabular implant positioning variations and resultant impingements and loss of joint congruence during daily activities.
Methods: 3D models of prosthetic hip joints (pelvis, proximal femur, cup, stem, head) were developed based on variations of acetabular cup's inclination (40°, 45°, 60°) and anteversion (0°, 15°, 30°) parameters, resulting in a total of 9 different implant configurations. Femoral anteversion remained fixed and determined as "neutral" with the stem being parallel to the posterior cortex of the femoral neck. Motion capture data of daily tasks were applied to all implant configurations. The motions were obtained from 4 healthy volunteers (mean age, 28 years) during routine (stand-to-sit, lie down) and specific activities (lace the shoes while seated, pick an object on the floor while seated or standing) known to be prone to implant dislocation and impingement.

While visualizing the prosthetic models in motion, a collision detection algorithm was used to locate abnormal contacts between both bony and prosthetic components. Moreover, femoral head translations (subluxation) were computed to evaluate the joint congruence.
Results: The simulations showed that collisions occurred at maximal ranges of motion in the anterosuperior part of the acetabulum. The more the inclination and anteversion were important, the lower the frequency of impingements was noted (e.g. 23% at 40°/0°, 13% at 45°/15°, 5% at 60°/30°). Subluxations followed the same trend (e.g. 4.0 mm at 40°/0°, 1.5 mm at 45°/15°, 0.2 mm at 60°/30°) and were observed as a consequence of impingements.
Conclusion: Daily tasks could expose the prosthetic hip to subluxation and impingement located in anterosuperior position. This location could be explained by the high hip flexion required to execute the motions (≥95°). Considering the kinematics solely, increasing inclination and anteversion seems to decrease possible conflicts, but mechanical aspects (stress, wear) should also be considered in the definition of ideal cup positioning.

FM112

MoM articulation Metasul versus contemporary Polyethylene. A long time follow up, 14/15 yrs. after primary implantation

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Objectives: Between 1992 and 2003 we used the same uncemented Zweymüller titanium hip implant 690-times with the articulation ceramic-polyethylene (UHWMP) and in 663 hips the metal-on-metal articulation Metasul with a forged high carbon alloy. In both articulations the same head diameter 28mm.
In 2003 we reported in cooperation with H.G Willert new findings of a metal-sensitivity reaction type ALVAL, detected in 5 Metasul-hips (0.8%) at the 5 yrs. follow up. (**A**septic **L**ymphocytic **V**asculitis **A**ssociated **L**esions).
Methods: Therefore continuous clinical and radiological follow-up examinations of all articulations 10 and 15 years after the primary implantation with a special regard to radiological wear associated alterations, such as radiolucent lines, osteolysis and MoM-signs of a hypersensity like ALVAL. Till now 202 hips had a 15yrs-follow up with a clinical and radiological examination.
Results: at 14/15 years follow up: 36 hips, 2.6% lost to follow-up. Ceramic-PE: All revisions 20 (2.9%), two of them wear related. MoM-Metasul: All revisions 28 (4.2%); wear related 12 (1.8%), aseptic loosening 5 (0.8%), late infections 5 (0.8%), others 7 (1.1%). Ten of all wear related revision (N12) were probably MoM-induced (1.5%) with seven (1.1%) histological confirmed perivascular lympho-plasmacellular infiltrations like ALVAL. Two cases needed a full stem and cup exchange, all other revisions "only" an inlay exchange to PE or HX-PE with later good functional results and new re-ossifications of the MoM-induced osteolyses.
Conclusios: In contrary to the in the first years detected MoM-cases, at the 14/15 years follow-up only a slight increase of the metal-induced revisions from 0.8% to 1.5%. No worrying progression, but compared to the low revision rate of Ceramic-PE no better Metasul-wear behaviour. In contrary to recently reported bad to worse results of large MoM-bearings no unacceptable high failures rate as ARMD or Pseudotumors. (**a**dverse **r**eaction to **m**etal **d**ebris). As a result of the regular performed 5, 10 and 15 yrs. follow-up all revisions were detected early and carried out in time. Only 1 extended osteolysis.

FM113

Ten-year comparative effectiveness of metal-on-metal vs ceramic-on-polyethylene THAs with a small diameter head

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Introduction: Large metal-on-metal (MoM) total hip arthroplasties (THA) have given rise to serious concerns. Studies comparing smaller head MoM to ceramic-on-polyethylene (CoP) THAs over a longer follow-up period are lacking.
Objectives: Our objective was to evaluate complications, radiographic and clinical outcomes in MoM vs. conventional CoP THAs during the first 10 years postoperative.
Methods: Prospective cohort study including all MoM (group 1) and CoP (group 2) THAs with an uncemented press-fit cup and 28 mm head. The following outcomes were compared: (1) Complication rates (infection, dislocation, revision) and all-cause mortality for patients operated upon between 3/1996 and 6/2011 (mean F/U 109 months, range 12–195); (2) Incidence of osteolysis; and (3) Clinical outcomes at 5 and 10 years postoperative. Evaluation was performed by an independent assessor. Cox regression was used to compare incidence rates of complications and mortality and multivariable linear regression to compare clinical scores.
Results: 3,341 THAs were included**,** 883 with MoM and 2,458 with CoP bearing. Crude incidence rates for complications were: 1.4 vs 0.9 cases/1000 person-years (p-y) for infection; 3.6 vs. 3.2/1000 p-y for dislocation; and 4.3 vs 2.4 /1000 p-y for all-cause revision. Adjustment for baseline differences substantially attenuated the higher rates for infection (adjusted hazard ratio (HR) 1.3, 95% CI 0.5; 3.0) and revision (adjusted HR 1.2, 95% CI 0.7; 2.2). Mortality was similar in both groups (adjusted HR 1.0, 95% CI 0.7; 1.3). Only in the MoM group 6 (0.7%) patients developed adverse local tissue reaction and required revision at a mean F/U of 73 months (range 17–139). No substantial difference in osteolysis at 5 and 10 years was observed between the two groups. At 5 years, 449 MoM and 1,444 CoP THAs were seen; at 10 years, 75 MoM and 653 CoP THAs. Clinical outcomes were similar both at 5 and 10 year F/U after adjusting for baseline differences.
Conclusion: Mid-term results did not substantially differ with respect to complications, radiographic and clinical outcomes between MoM and conventional CoP THAs, suggesting no major advantage for use of a small head MoM bearing in the first 10 years postoperative. However, the potential disadvantage of metal wear debris remains a concern even with smaller head sizes as evidenced by an adverse local tissue reaction in 6 patients in the MoM group.

FM114

Recovery of hip muscle strength after hip arthroscopy in patients with symptomatic femoroacetabular impingement

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Introduction: Patients with symptomatic femoroacetabular impingement (FAI) present with hip muscle weakness. The restoration of hip muscle strength after hip arthroscopy to address FAI is therefore a major concern in this cohort of young and active patients. Aim of this study was to prospectively evaluate hip muscle strength of patients with symptomatic FAI 2.5 years after hip arthroscopy.
Methods: Hip muscle strength of 8 patients with symptomatic FAI (age: 29 ± 10 years) was evaluated preoperatively and 2.5 years after hip arthroscopy, and was compared to 8 healthy matched controls. Maximal voluntary contraction (MVC) strength was measured for all hip muscle groups (adductors, abductors, internal rotators, external rotators, flexors, extensors) using hand-held and isokinetic dynamometry. At follow-up, we also used (1) the Hip Outcome Score (HOS) to evaluate hip pain and function during activities of daily living (ADL) and sport activities (sport), (2) the symptom-specific well-being outcome to assess the acceptability of the current health state related to the hip, and (3) the global treatment outcome to evaluate hip arthroscopy.
Results: Patients showed significant increases in MVC strength for all hip muscles (9 to 59%, $p < 0.05$). At follow-up, only hip flexor MVC strength was lower for patients than controls (–18%, $p = 0.03$), and patients had HOS scores of 92 ± 7 and 82 ± 18 for ADL and sport, respectively. One patient (out of 8) was "very satisfied" with the health state of the operated hip, 3 patients were "somewhat satisfied" and 4 patients were "neither satisfied nor dissatisfied". Four patients (out of 8) reported that hip arthroscopy "helped a lot", 3 patients that it "helped", and one patient that it "helped only little".
Conclusion: Patients with symptomatic FAI recovered their hip muscle strength to normal levels 2.5 years after hip arthroscopy, except for hip flexors. Although hip muscle strength was restored, clinical outcomes were good-to-excellent, and general positive evaluation of surgery at follow-up, half of the patients were not completely satisfied with their postoperative health state related to the hip.

FM115

Enlargement of the anterior approach to the hip joint: Potential risk to neurovascular structures

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Introduction: Many studies favour the anterior approach (AA) for total hip arthroplasty. However, some report high complication rates, especially when using the mini-incision technique. In cases of intraoperative complications, the surgeon may need to enlarge the approach distally by splitting the interval between the rectus femoris (R) and vastus lateralis (VL). This extension endangers neurovascular structures, namely the branches of the femoral nerve (F) and of the lateral femoral circumflex artery (LCA). The purpose of this study was 1) to demonstrate the proximity of neurovascular structures with

regards to AA at the hip joint and 2) to investigate if the AA could be safely enlarged distally.
Methods: Seventeen cadaveric hemipelves with legs from twelve specimens were dissected. All nerve branches to the VL, vastus intermedius (VI), Sartorius (S) and R as well as vessels arising from the LCA were traced. The entrance of each nerve branch into its specific muscle belly was recorded and the distances to two reference lines were measured: 1) the horizontal line through the middle of the neck of the femur proximal to the intertrochanteric line (X1) and 2) the horizontal line through the lower margin of the lesser trochanter (X2). A Cerglage hook was inserted between X1 and X2 and damage to neurovascular structures was recorded.
Results: The VL was innervated proximally and distally, the VI medially and laterally by branches of F. The proximal part of VL, lateral part of VI, the S and R received branches mainly from between X1 and X2; In contrast, the S and R received nerve branches more anteriorly and superficially, a safe distance from the enlarged AA. The LCA always divided into its branches between X1 and X2. The distal part of the VL and medial part of the VI were innervated distal to X2. The insertion of the Cerclage hook regularly led to damage or tearing of muscle branches to the VL, VI and branches of LCA while branches to the S and R remained untouched.
Conclusions: The distal enlargement of the AA to the hip joint results in direct denervation of proximal lateral parts of the quadriceps muscle. Additionally, damage to branches of the LCA is very likely. The enlargement of the AA distal to the intertrochanteric line as well as the placement of instruments over the AA should be avoided.

FM116

Evaluation of Bernese periacetabular osteotomy: Short Term Results of a consecutive series of 194 patients

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Introduction: Periacetabular osteotomy (PAO) aims to influence the natural history of malformed hip joints (acetabular dysplasia and retroversion) by improving femoral head containment. Whereas long term outcome in terms of OA has been documented over 20 years, the present study focuses on its peri- and postoperative morbidity and patient's short term benefit.
Material: Prospectively documented consecutive series of 194 PAOs performed by 3 surgeons. Demographics, hospital stay, blood transfusions, intraoperative and postoperative complications and time to recover as well as subjective outcome measure in terms of preoperative and one year WOMAC scores were recorded. Quality of correction was assessed on one year postoperative x-rays. Risk factors for adverse events (blood transfusions, inadequate corrections, non-unions etc) were analysed using univariate analysis.
Results: Indications were dysplastic hips in 170 and acetabular retroversion in 24. Mean age was 26 years (10 to 48). Mean hospital stay was 9 days (range; 4–21 days). Recovery time in terms of use of gait assistive devices was 13 weeks (range, 8–24 weeks). In 16 cases an allogenic blood transfusion was necessary with a mean number of blood units of 2.75 (range 1–7). Relevant nerve damage could be observed in five cases; irritations of the N. cutaneus femoralis lateralis in 19 patients. Elevated blood loos and nerve irritations were more common in reoperations. Intraarticular OT as well as interruption of the posterior pelvic column were seen twice in each case. Loss of correction occurred in three and fatiguing fractures of the lower pubic arm in 12 cases. Four cases presented symptomatic non-unions and needed surgical revision. All of them affected the ischium. Asymptomatic non-unions could be detected in 29 cases. In terms of WOMAC the mean count decreased from 19.3 preoperatively to 13 points one year postoperatively. The mean subjective hip value one year postoperatively was 72% (range; 10–100%) with a mean subjective benefit of 75% (range; 0–100%). In 147 cases patients were satisfied with the operation and willing to repeat it. Radiographically, a reduction of the mean acetabular index from 20.5° to 1.5° was achieved, 95% being in-between –10° to 10°. The mean CE- angle increased from 13.8° to 35.0°, 97% lying above 25°.
Conclusion: The PAO is a demanding operation for surgical correction of acetabular dysplasia and retroversion. In this series good radiographic and clinical results could be reached by contrast to moderate blood loos and low rate of complication in cases of initial surgery.

FM117

Outcome after labral reconstruction for treatment of femoroacetabular impingement

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Introduction: Femoroacetabular impingement (FAI) is a well-described etiology for the development of osteoarthritis (OA) in young adults. FAI is associated with pathological deformities of either femoral head (cam-type FAI) or acetabulum (pincer-type) that leads to damage of the acetabular rim including the acetabular labrum (AL) and cartilage. In pincer-FAI often labrum degeneration is present which makes preservation of the remaining labral tissue impossible. In several studies preservation of the AL showed a significant better clinical outcome than resection due to a postulated sealing effect. To restore labral sealing we reconstructed the AL with the Lig. capitis femoris. Clinical and radiological outcome was assessed after surgical hip dislocation and labral reconstruction and compared to a matched group of patient with labral reattachment.
Patients and Methods: Between 2008 and 2010 eleven patients (13 hips) with FAI underwent surgical dislocation of the hip with reconstruction of the AL. 6 men and 5 women with a mean age of 36 years (22–51 y) were followed for a mean of 21 months (9–45 m). Hip function was assessed with Oxford hip score (OHS) and VAS for satisfaction and pain (0–100) before and after surgery. Integrity of the reconstruction was controlled with Arthro-MRI in 11 out of 13 hip. The matched control group of 11 patients had surgery for FAI during the same time period.
Results: The OHS increased from an average of 29 (SD 9.1) to 41.8 (SD 4.8) postoperatively. The mean improvement of OHS was 13.2 (SD 13.9). Eleven out of thirteen hips had an improvement of OHS ≥6. Patient satisfaction improved from preoperatively 37.3 (SD 33.3) to 87.1 (SD 14.2) on a VAS scale with a maximum of 100. Additionally patients were asked about rest and load pain, which showed a mean VAS for rest pain 5.4 (SD 6.6) and for load pain 22.1 (SD 22.7) postoperatively. In Arthro-MRI the reconstructed AL shows isointensity and the comparable size as the native AL.
The data of the control group shows similar results with no statistically significant difference between the two groups.
Conclusion: The reconstruction of the AL yields good results in the majority of patients, comparable to hips where the native AL was preserved. The results are superior to those reported in the literature, where the damaged labrum was resected. In absence of other reconstructive options it has to be considered as a safe option and with no adverse effects.

FM118

Metal ions intoxication after hip arthroplasty. Case report and literature review

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Introduction: Metal on metal (MoM) resurfacing hip arthroplasty (RHA) is the alternative to total hip arthroplasty (THA). Metallosis, one of its complications, is related to the immunological response to the metalic debris and metal ions released through mechanical deterioration of metal implants. The elevated concentrations of the metal ions (cobalt, chrome) in human fluids, can be responsible for the systemic intoxication. We present a case of the patient who after the RHA developed the metallosis, high cobalt and chrome concentrations, and symptoms of intoxication.
Methods: A 60-year-old patient underwent the RHA of the left hip. DUROM implants were used: 56 mm cup and 50 mm head. Few months after RHA he complained of fatigue, lost of concentration, peripheral paresthesia, dysgueusie with metallic taste, weight lost and hearing impairment with tinnitus. The implant position was evaluated on the basis of CT scan. The MRI was performed. The laboratory investigation addressed thyroid, renal and hepatic function. The cobalt and chrome ions level in blood and urine was estimated. On the 16th month the hip revision was performed.
Results: Cup anteversion was 31.5° and inclination was 64.5°. MRI reveled the pseudotumor of 50 × 75 mm. Thyroid hormones showed the subclinical hypothyroidism. Cobalt concentrations were 206 µg/l and 1794 µg/l in blood and urine respectively. Chrome level was 65.7 µg/l in blood and 298 µg/l in urine. There were no signs of infection. Revision surgery was followed by clinical improvement, thyroid hormone normalization and decrease of metal ions concentration in blood. The removed implant showed equatorial stripe wear zones.
Conclusion: There are few report cases describing the intoxication with metal ions in patients after the hip prosthesis surgery. The reported symptoms are hearing and sight impairment, neuropathy, cardiopathy, weight lost, taste disturbance, cognitive problems, hypothyroidisme. The excessive metal components wear, resulting in metal ions accumulation, were caused by:

1 massive third body wear mechanism (remained particles of ceramics after revision surgery)
2 edge loading du to excesive acetabular inclination in MoM cases.
We propose to identify two categories of patients who are at risk of metal ions intoxication after the hip surgery.

FM119

Pubic rami fractures in the elderly – an underestimated injury

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Objective: To evaluate patient characteristics and natural history of pubic rami fractures in elderly people with a special focus on the frequency of concomitant posterior pelvic ring lesions and the percentage of secondary operated patients due to conservative treatment failure.
Study Design: Retrospective cohort study. Patients were treated in university hospital which is equivalent with a level I Trauma center.

Patients and Methods: We analysed 132 consecutive patients, >65-year old, presenting with low energy-trauma pubic rami fractures at our emergency department from January 2009 to December 2011.
Results: Mean age of patients was 84 years (range 66–100). Women were affected 6 times more frequently than men. 15 per cent of patients lost their previous independency permanently due to the injury. 98 per cent of previously independent patients (community dwellers) required temporary hospital care for a median duration of 39 days (IQR 28–52). One-year mortality was 20 per cent. A concomitant posterior pelvic ring lesion was identified by CT-Scan in 54 per cent of patients. In 4 per cent of the patients secondary operative fracture stabilisation was performed.
Discussion: Pubic rami fractures are frequently associated with concomitant posterior pelvic ring injuries making these injuries more unstable than generally assumed. Based on this fact and the long duration of acute hospital stay, more aggressive management of these injuries may be considered. The principle aims in this patient population are satisfying pain management, quicker mobilisation, less dependency and return to previous place of residence.

Free communications IX – Shoulder

FM120

Tubercle of the Greater Tuberosity. A suitable landmark for the posterior approach to the shoulder joint

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Introduction: Many surgical approaches to the posterior shoulder joint have been utilised. Deep dissection generally includes the development of the internervous plane between the infraspinatus and teres minor muscles (IS/TMI). Identifying this interval is crucial, as a dissection carried out more proximal leads to denervation of parts of the IS and a dissection further distal renders damage to structures in the quadrilateral and triangular space. To our knowledge, there are no reports detailing anatomical landmarks relative to the IS/TMI.
Inspection of the anatomical insertion of the external rotators reveals a tubercle (T), corresponding to a punctum maximum, at the inferior dorsal border of the greater tuberosity, where the IS merges with the TMI. The purpose of this study was to determine (1) the anatomical and topographical relationship between T and IS/TMI and (2) to prove whether T could be used clinically as a guide during surgical approach to the posterior shoulder joint.
Methods: Twenty-five, formalin fixed, human cadaveric shoulders were dissected. The (IS/TMI), the inferior border of the glenoid (IBG), T and the humeral insertion of IS and TMI were identified. Structures evaluated and distances measured during dissection included (1) the distance from T to the IS/TMI, (2) the distance from T to the horizontal line through IBG and 3) the distance from IBG to the IS/TMI. Measurements were taken in humeral neutral rotation with the arm fully adducted.
Results: In all except one specimen the IS/TMI was located immediately proximal to T. The mean distance between T and IS/TMI was recorded 3.3 mm (range –2 to 8, SD +/– 2.4). The mean distance between the IBG to the IS/TMI was recorded 4.6 mm (range 0 to 10, SD +/– 3.3). In all shoulders T was found proximal to the IBG (mean distance 8.1 mm, range 4 to 15, SD +/– 3.1).
Conclusion: Detailed anatomical knowledge is imperative to avoid surgical complications during the approach to the posterior shoulder joint. Our study reveals that the interval IS/TMI constantly corresponds to a point a few millimetres proximal to T. As T is easily located by blunt dissection it is a suitable guide during surgery. In contrast to other landmarks T is independent of gender, body size and position of the shoulder joint as the T moves with the position of the humeral head.

FM121

A 3D classification of Glenoid Version and Humeral head Subluxation of Osteoarthritic Shoulders

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Introduction: Addressing glenoid bone wear and humeral subluxation is crucial for the treatment of osteoarthritic (OA) shoulders. Classifications of glenoid morphology are based on 2D analysis. As deformations may appear in all directions, glenoid wear and subluxation of the humeral head are systematically underestimated when out of plane. We developed a 3D objective method to measure the glenoid version, medialization and the subluxation of the humerus and defined a systematic classification.
Methods: 53 OA shoulders were analyzed using regular CT's. A 3D geometric model and a coordinate system were defined using accurate bony landmarks. **VERSION** angle (Va) is the angle between the glenoid surface and the scapular axis. Va was divided in V1 when Va less 10deg, V2 when Va between 10 and 20deg, and V3 when Va more than 20deg. Version **ORIENTATION** (Vo) is the angle between the axial (horizontal) plane and the direction of the maximal glenoid deformation. Vo is identified posterior (P), postero-superior (PS), postero-inferior (PI) or anterior (A). Glenoid **MEDIALIZATION** (M) is the medio-lateral position of the glenoid center. **EXCENTRICITY** (E) is a measure of the humeral head subluxation relative to the scapular plane. OA shoulders were classified with V, O, M, E parameters.
Results: OA shoulders were 20.8% V1, 52.8% V2, and 26.4% V3. Some (27%) V1 shoulders were medialized, but none was eccentric. V2 shoulders were mainly P (39.3%) and PS (39.3%), but also PI (14.3%) and even A (7.1%). V2 shoulders were sometimes E (14.3%), or M (42.9%), but never M and E. V3 shoulders were essentially P (85.8%), with a few PI (7.1%) and PS (7.1%). V3 shoulders were sometimes (28.6%) E, sometimes (42.9%) E and M, but never only M.
Discussion: This study confirms that glenoid wear and humeral subluxation of OA shoulders occur not only in the axial (horizontal) plane. A 3D objective method allows measuring accurately the deformations. We propose a new classification of AO shoulder, based on 3D measures taking into account the version, orientation, medialization and excentricity (VOME). The better recognition of the glenoid morphology of OA shoulders should help to plan the surgery before TSA.

FM122

Conversion of Hemi- or Total- to Reverse Total Shoulder Arthroplasty:

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Background: After failed hemi- (HA) or total shoulder arthroplasty (TSA) conversion to a reverse total shoulder arthroplasty (RTSA) has shown to be a reliable option, as the more constrained prosthetic design allows to compensate for muscular imbalance and addresses the glenoid bone loss and erosion.
The aim of this study was to evaluate the clinical outcome and the complication and revision rate following conversion of HA or TSA to RTSA with or without humeral stem removal.
Methods: Between 2005 and 2011,48 HA and 8 TSA were converted to an Anatomical reverse shoulder arthroplasty system (Zimmer, Winterthur, Switzerland). Mean age at conversion was 67 (range: 44–87) years and mean time between index surgery and conversion was 38 (range: 0–147) months. 11 patients had to be excluded leaving 45 patients (32 with and 13 without stem exchange) with a complete clinical and radiological follow up of at least 12 months.
Results: Mean blood loss (485 vs 831 ml; p = 0.001) and surgical time (118 vs 176 minutes; p = 0.0001) was significantly lower in patients without stem exchange.
We identified 13 intra- and 9 post-operative complications leading to 9 re-interventions (in 6 patients (14%)) in the 43 cases were the stem had to be exchanged compared to one intra- and 2 post-operative complications with one (8%) re-intervention in the 13 cases were the stem could be left in place.
The mean improvements of the relative and absolute Constant scores were 28 (range: –15–100) % and 21 (range: –11–64) points (p = 0.0001).

There were however, no significant differences between the groups with or without stem removal.
Conclusion: Conversion from HA or TSA to RTSA without stem removal reduces the length of surgery of almost one hour, and the intraoperative blood loss of about 350 ml. Furthermore it minimizes the risk of sustaining an intraoperative complication by the factor 5 and the risk of undergoing a conversion related revision by half.

FM123

Clinical and Radiographical Mid- and Long-term Evolution in the Throwing Shoulder 6.8 resp. 21 Years after Completion of a Professional Handball Career

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Introduction: The shoulders of overhead throwing athletes are highly stressed. Structural abnormalities are found in 93% of the throwing shoulders (TS) of professional handball players. What happens with respect to these pathological changes after completion of the professional handball career is not well known. Jost et al. examined the shoulders of thirty fully competitive professional handball players in 2005. In the here presented study, we were able to reevalute 20 of these 30 players, which had terminated their career on average 6.8 years ago. None of them had received shoulder surgery. To compare these mid- with the long-term evolution of the pathological changes after completion of the professional handball career, we included also 17 former professional handball players, that terminated their career on average 21 years ago.
Methods: The Constant Score increased from 88.1 during their career to 97.3 at the 6.8 year follow-up (FU) and 96.7 at the 21 year FU. External rotation remained significantly increased in the TS when compared to the non-throwing shoulder (NTS) at the 6.8 year FU. The amount of subjects with abnormalities in the TS increased not significantly from 93% during the professional career to 95% at the 6.8 year FU and 100% at the 21 year FU. Interesting was the fact, that the players had significant more pathological changes in their TS (93%) compared to the NTS (85%) during their professional time, but there was no difference between the TS and NTS in both FU time points. Looking at the pathological changes in the supraspinatus tendon, we found a significant decrease in tendinopathies from the initial examination to the 6.8 y FU (9 vs 3 shoulders) and a significant increase of the partial tears (8 to 14 shoulders). No full thickness tears were found in all three time-points.
Results: Osseous changes were recognized in 70% of the players during their career. This number decreased to 18% at the 21 year FU. Also the size of ganglions decreased significantly over time and the amount of postero-superior impingements decreased from 40% during the career to 5% at the 6.8 year and 0% at last FU.
Conclusion: This data suggests that overhead throwing athlestes have good to excellent clinical scores up to 21 years after finishing their career. Increased external rotation persists over time. Partial supraspinatus tendon tears do not progress to full thickness tears up to 21 years after termination of a professional handball career. Osseous changes and ganglions may “heal” over time.

FM124

Glenoid erosion in patients with shoulder hemiarthroplasty: an analysis of 118 cases

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Glenoid erosion in patients with shoulder hemiarthroplasty: an analysis of 119 cases.

Background: Glenoid erosion is an important and frequent, but poorly predictable finding after hemiarthroplasty of the shoulder. The purpose of this study was to analyse the degree of glenoid erosion after hemiarthroplasty of the shoulder and to determine predisposing preoperative factors for advanced glenoid erosion. Our hypothesis was that very horizontal positioning of the prosthetic head may result in a gouging mechanism against the glenoid and therefore promote excessive glenoid erosion.
Methods: We retrospectively reviewed radiological data and clinical charts of all patients that had hemiarthroplasty of the shoulder between 2002 and 2011 at our institution. Minimum followup was 12 months (only if massive erosion ocurred earlier than one year postop, patient data were included in the analysis). 118 prostheses in 113 patients were included. Evaluation was performed by two independent observers. Glenoid erosion was graded as none (°0), mild (°1), moderate (°2) and severe (°3). Positions of the prosthetical components in relation to the bony architecture of the shoulder were analyzed over the course of follow up. Preoperative CT-scans were reviewed for condition of the glenoid. Clinical charts were reviewed for possibly predisposing factors such as rheumatoid arthritis and chondrocalcinosis.
Results: Mean FU was 31 months (range, 5 to 86 months). Erosion was absent in 31 (26%), mild in 30 (25%), moderate in 30 (25%) and severe in 27 (24%) of 118 shoulders. Out of 15 patients with a humeral head angle to the glenoid (in adduction) >50°, 13 developed moderate or severe erosion. However, these observations were not statistically significant. Preoperatively existing cystic alterations of the glenoid were found in 36 (31%) of 118 shoulders. 17 of these developed severe, 13 moderate glenoid erosion. Of 11 shoulders of patients with rheumatoid arthritis, 6 developed severe, 5 developed moderate glenoid erosion.
Conclusions: An angle of the humeral head to the glenoid above 50° degrees appears to be detrimental to the survival of the glenoid. However, also preoperatively existing cystic alterations of the glenoid as well as as rheumatoid arthritis seem to importantly predispose for glenoid erosion. In these subgroups of patients, total shoulder arthroplasty instead of hemiarthroplasty should be considered.

FM125

The Single Best and The Best Combination of Radiographic Projections to Detect Head Screw Perforations of the PHILOS Plate – A Cadaver Study

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Introduction: The PHILOS plate is a frequently used implant for open reduction and internal fixaxion of fractures of the proximal humerus. Head screw cut out a common complication of the locking head screws due to rigid fixation combined with avascular necrosis, secondary displacement or the use of too long screws. Left untreated, severe destruction of the glenoid has been reported. The aim of the study was to identify reliable radiographic (rx) projections to detect screw cut outs.
Material and methods: The PHILOS plate was fixed to 6 proximal humeri of 3 whole-body human cadavers. The correct, subchondral head screw placement was controlled visually and by fluoroscopy. Six rx examinations were performed: anteriorposterior (ap) in internal rotation (apIR); ap in neutral rotation (ap0); ap in 30° external rotation (apER); axial in 30° (ax30) and 60° (ax60) abduction in neutral rotation and the outlet view. Each head screw (n = 9) was sequentially exchanged to perforate the humeral head with the tip and all six rx were repeated for each cut out. In a randomized and blinded first reading, two examiners independently decided whether cut out was present or not. In a second reading, the best combinations of two, three and four projections were examined again for cut out and identification of screw position. Inter-rater reliability was calculated and, in case of disagreement, a consensus reading was appended. Based on this sensitivity (sens) and specificity (spec) were assessed.
Results: All readings had substantial to excellent inter-rater agreement (kappa >0.72). The best single projection was ax30 (sens 76%) and the worst was the outlet view (sens 17%). Standard combination of apIR/outlet reached a sens of 54% and 81% in combination with ax60. The best combination of two was: apER/ax30 (90% sens), of three: apIR/apER/ax30 (96% sens) and of four: apIR/ap0/apER/ax30 (100% sens and 100% spec even for screw position).
Conclusion: With the use of standard radiographs (ap/outlet), especially with the arm in internal rotation (e.g. in a sling), up to 46% of screw cut outs may be missed. The single best radiographic projection was an axial view with 30° abduction, which projected screw tips in the inferior humeral head hemisphere better than a standard axial view. To account for all cut outs and their correct screw position a combination of 4 projections was needed. These clinically feasible radiographs help to detect screw perforations of the PHILOS plate.

FM126

The critical shoulder angle: reproducibility of measurement using conventional radiographic and MR tomographic images

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Background: The critical shoulder angle (CSA) is a new radiographic parameter, which describes the lateral extension of the acromion in relationship to the glenohumeral joint line on a high quality true ap view of the shoulder. A CSA from >35° has been shown to be a risk factor for developing a rotator cuff (RC) pathology. Consequently an anterolateral acromioplasty has been recommended in patients requiring RC surgery. As it is challenging to obtain a true ap view of the shoulder without fluoroscopy and a MRI is available in the majority

of patients undergoing RC surgery, we hypothesized that CSA can be reproducibly determined on MRI.
Method: 33 high quality true ap view of the shoulder and an corresponding MRI were selected. On the X-ray the CSA was determined according to Moor. On the MRI the CSA was measured on three consecutive coronal T1 images. The first image to be measured was defined with help of the scout axial view showing the anterolateral border of the acromion; the level to be considered was determined as the first anterior image representing the lateral border of the acromion and the glenoid simultanously. The second and third level of measurement were performed on the two consecutive images posteriorly to the first one. Each record was evaluated three times by two attending orthopedic surgeons and one interne respectively.
Results: Both techniques showed excellent intra- und inter-observer reliability (intra ICC, inter ICC >0.9). The average CSA was 34.1° (SD +/– 3.6°) on X-ray, 35.2(SD +/– 3.9°) on MRI level 1, 36.6° (SD +/– 4.0°) on level 2 and 38.1° (SD +/– 4.0°) on level 3. Correlation between X-Ray CSA and MRI CSA was good (Pearson r >0.6) for all levels. The best correlation was measured at level 2 (Pearson r = 0.689). However the absolute value of the critical shoulder angle differed significantly from X-ray compared to level 2 measurements (p >0.0001).
Conclusion: The CSA can be reproducibly determined on MR tomography and can offer an alternative technique of measurement when conventional X-ray is of poor quality or not available. Although correlation between X-ray and MRI measurements were found to be good, the absolute CSA value on X-ray cannot be directly compared to MRI. Correspondingly a clinical recommendation based on MRI can not be done yet. As MRI is obtained in a reliable standardized manner, further investigations should be considered to determine which CSA in MRI is clinically relevant.

Free communications IX – Knee

FM127

Analysis of muscular properties after ACL reconstruction: comparison between BPTB versus pedunculated hamstring grafts – an analysis of 111 patients

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Introduction: Main objective of ACL reconstruction is to re-establish kinematics and function of the injured knee. Several operative techniques have been described. A widely used technique is the bone-patellar tendon-bone grafts (BPTB). Due to less invasive technique and less anterior knee pain postoperatively, a trend towards hamstring grafts is noted in the last few years in our clinic. Clinical experience with hamstring grafts are positive. The aim of this cohort study is to assess objectively this perception and to compare both techniques regarding functional outcomes.
Material and Methods: Between 2007 and 2010 205 patients underwent primary ACL reconstruction by one single, experienced orthopaedic surgeon. Data of these patients were collected in a retrospective manner. Patients with previous surgery (ipsi- and contralateral knee), complex ligamentous reconstruction, contralateral knee problems and age >50 years were excluded as well as meniscal suture and re-reconstructions. 145 patients meet inclusion criteria. 111 (77%) patient were accessible to follow-up (48 women, 63 men), thereby 43 BTB and 68 pedunculated hamstring grafts, with mean duration of follow-up of 45 months (range 24–71 months). At follow-up, quadriceps and hamstring strength, power and acceleration were measured with a resistance device and accelerometer (Myotest®). Static and dynamic balance was measured with accelerometer. Differences between both groups were calculated considering side differences (operated versus non-operated side). Data were analyzed with linear regression methods adjusting for age and sex.
Results: Deficit between operated and non-operated side was statistically significant smaller in the BPTB group by 7.8% (95% CI 3.3 to 12.3) for quadriceps movement velocity and by 9.7% (95% CI 3.8 to 15.7) for quadriceps power as in the hamstring group. There was no difference in quadriceps strength (5.7% (95% CI –8.5 to 19.8) between both groups BPTB vs. hamstring. The data were adjusted for age and sex. Absolute values (i.e. not comparing to non-operated side) showed no differences between the BPTB and hamstring group. For example, the difference in hamstring strength was 0.49 Nm (95% CI –1.64 to 0.649) in favor (but non-significant) of the BPTB, for quadriceps strength the difference was 0.08 Nm (95% CI –1.24 to 1.07). There was no significant difference between both groups concerning dynamic balance (0.12 sec, 95% CI –0.19 to 0.42) and the KOOS (–0.93 points, 95% CI –2.7 to 0.83).
Conclusion: Interestingly we observed that patients operated with a BPTB showed significant less deficits (power and velocity) between operated and non-operated side compared with the hamstring group. Otherwise no significant differences in the different muscular tests could be objectified, especially no statistically significant weakness of the knee flexors in the hamstring group. Results of static and dynamic balance were comparable in both groups.

FM128

Physeal-sparing anterior cruciate ligament reconstruction in children – a retrospective analysis of 12 patients

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Introduction: Due to strenuous activities in sportive children, injuries of the anterior cruciate ligament (ACL) are increasing. In case of instability and/or additional meniscal tears it is generally accepted to reconstruct midsubstance ACL tears even in immature patients to prevent meniscal and chondral structure from secondary damage. Controversy regarding operating technique (physeal sparing vs. transphyseal) in young athletes with widely open physes remains unsolved. This study reclaims the results of a physeal-sparing ACL reconstruction techinque in skeletally immature patients.
Methods: Between 2006 and 2010 12 patients (2 girls, 10 boys, age 10–13, Ø 11.6 years) underwent physeal-sparing primary ACL reconstruction (1 bilateral intervention) by one single, experienced orthopaedic surgeon. In two patients concomitant bucket handle tears were sutured, in one patient a partial medial meniscectomy was performed. Femoral and tibial tunnels were drilled entirely in the femoral and tibial epiphysis under image-intensifier control to prevent injury of the open physes. Data of these patients were collected retrospectivley. All patients were accessible to follow-up with a mean duration of follow-up of 59 months (range 39–80 months) and assessed by clinical examination (ROM, KT-1000) and radiological analysis (knee status and long leg radiographs). Functional status was assessedwith use of Lysholm knee score, Tegner activity scale and IKDC-2000 questionnary.
Results: In 2 patients reoperation was necessary due to graft failure (one traumatic and one non-traumatic; 13 month and 49 month after primary operation). Two patients developed overlength of affected limb; one with 20 mm overlength and slight varus malalignement after re-physeal-sparing ACL reconstruction, the second developed arthrofibrosis and overlength of 12 mm. The former was treated by temporary epiphysodesis, the latter conservatively. No early closure of epiphyseal plate occurred. One patient with intact but slightly elongated graft required meniscal suture 34 month after ACL reconstruction after traumatic medial meniscal lesion. Instrumented arthrometer (KT-1000) testing showed significant side-difference compared with unaffected knee. IKDC subjective evaluation form score was in between 90 and 100.
Discussion: This study demonstrates that arthroscopic ACL reconstuction sparing the physes in immature children results in patient satisfaction and good clinical results although hyperstimulation of the physes with overgrowth and limb malalignement as well as graft failure in this highly active children remains a concern.

FM129

Clinical outcome of bone-patellar tendon-bone versus pedunculated hamstring grafts for ACL reconstruction – a retrospective analysis of 111 patients

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Introduction: The reconstruction of anterior cruciate ligament (ACL) is considered as a standard procedure in orthopaedic surgery. Several techniques have been described and different graft choices are possible.
Due to morbidity at the site of harvesting in BTB a trend towards hamstring-tendon grafts is noted in the last few years in our clinic. Aim

of this study is to compare clinical outcome after ACL reconstruction with BTB and pedunculated Hamstring-grafts by a two-incision technique.
Methods: Between 2007 and 2010 205 patients underwent primary ACL reconstruction by one single, experienced orthopaedic surgeon. Femoral and tibial tunnels were drilled in an outside-in two-incision technique guided by Phusis® drill-sleeves. BTB grafts were implanted upside-down and fixed articular sided by interference screws. In the hamstring group semitendinosus and gracilis tendons were harvested without detachement at the tibial insertion. The four stranded graft was implanted retrograd and fixed on both side with interference screws. Data of these patients were collected in a retrospective manner. Patients with previous surgery (ipsi- and contralateral knee), complex ligamentous reconstruction, contralateral knee problems and age >50 years were excluded as well as meniscal suture and re-reconstructions. 145 patients meet inclusion criteria. 111 (77%) patients were accessible to follow-up, thereby 43 BTB and 68 pedunculated hamstring grafts, with mean duration of follow-up of 45 months (range 24–71 months). All patients were assessed by clinical examination (ROM, KT-1000) by one orthopaedic surgeon and radiological analysis was performed. Functional status was assessedwith use of Lysholm knee score, Tegner activity scale, KOSS and IKDC-2000 questionnary.
Results: Overall revision rate was 12.5% (19 of 152 patients). In 7 patients reoperation was necessary due to graft failure (5 patients BTB group, 2 patient hamstring group). Meniscal lesions (4 patients), lavage of hemarthros (2 patients) and cyclops formation (5 patients) were other indications for reoperation. One patient with cartilage lesion was treated by arthroscopic microfracturing. No septic arthritis occured. Anterior drawer measured by KT-1000 Arthrometer was 5.9 mm (range 2.0–12.5) and 4.1 mm in opposite knees (range 1.0–10.0), no difference was noted between the two groups. IKDC subjective evaluation form score was 91 (range 69–100; 90.1 BTB group, 90.7 hamstring group).
Discussion: Acceptance after ACL-reconstruction in both groups (BTB vs. pedunculated Hamstring graft) is high with satisfying subjective results without significant differences in IKDC evaluation in both groups. Instrumented arthrometer testing in our patients showed no significant difference between BTB and soft-tissue grafts, contrary to previous reports. No correlation between elevated anterior laxity after ACL-reconstruction (KT-1000 Δ >3 mm) and functional status was noted.

FM130

Evaluation of intra-ligamentary radiodensity marker after ACL reconstruction

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Introduction: The success rate of primary ACL reconstruction varies from 69% to 95%. Early clinical and radiographic diagnosis of failure or loosening can be difficult. The aim of the present study is to retrospectively evaluate the use of radiologically visible markers in the ACL, serving as a new potential diagnostic tool in early diagnosis of ACL graft rupture and insufficiency.
Methods: Twenty patients were included in the study. ACL reconstruction was performed with use of a hamstring autograft in hybrid fixation technique. During surgery the hamstring graft was marked with two radiodense sutures, one at the tibial and one at the femoral tunnel opening. X-rays were performed postoperatively, after 6 weeks and at 12 months. Additionally, at a minimum follow-up of 12-months measurement of ap-translation in 30° knee flexion by using a Rolimeter device and clinical examination with IKDC score was performed. Four marker distances were measured in antero-posterior as well as in lateral x-ray views and the positional change between the measurement times was calculated.
Results: In two measured distal anteroposterior distances statistically significant changes could be detected between 6 weeks and 12 months postoperatively in case of one MRI-documented ACL rerupture and in six patients with ACL elongation ($p = 0.04$ and $p = 0.025$). Significant relationships could be detected between the change from 6 weeks to 12 months of two measured distal distances on ap x-rays and clinical ACL insufficiency ($p = 0.021$ and $p = 0.01$). In lateral x-rays, changes of the marker distances were highly variable depending on the projection and did not correlate with clinical ACL insufficiency. One failure (extra-ligamentary marker migration) was seen 12 months postoperatively. Measurements of the marker distances on x-rays showed an excellent interobserver reliability ($\kappa = 0.968$).
Conlusion: The application of radiodense ACL graft markers seems to be a useful diagnostic tool for diagnosis of ACL graft rupture and insufficiency. However, several limitations such as reproducible radiologic imaging have to be addressed in further studies.

FM131

Landmarks of the normal adult human trochlea based on axial MRI measurements: A cross-sectional study

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Background: For deepening trochleoplasty, a procedure used worldwide to correct trochlear dysplasia, only few important surgical steps are described precisely. Important surgical landmarks, such as optimal cartilaginous trochlear depth and percentages of the new lateral and medial facet remain unanswered. This study therefore aims at describing normal trochlear geometry based on cartilaginous measurements in the general population.
Methods: We conducted a prospective cross-sectional study (January 2011–August 2012) in adult patients (16–35 years) without trochlear dysplasia, who underwent magnetic resonance imaging (MRI). The main outcome was trochlear depth. The secondary outcome was the lateral / medial facet ratio. Measurements were made on the first cut from proximal with complete cartilage coverage. Measurements are reported as means and standard deviations with corresponding 95% confidence intervals. Differences between men and women were assessed. Inter- and intraobserver reliability were determined.
Results: 53 patients (69.8% men) were included. Mean age was 24.6 years (SD +-5.5). Overall mean trochlear depth revealed as 4.0 mm (95% CI 3.6–4.3). Values differed significantly by gender ($p = 0.0271$) with a mean of 3.4 mm (95%CI 3.0–3.8) for women and a mean of 4.2 mm (95% CI 3.8–4.7) for men. The mean ratio between the lateral and medial facet was 1.71 (95% CI 1.62 – 1.80), the lateral facet contributing 62.6% (95% CI 61.3–63.8) and the medial facet contributing 37.4% (95% CI 36.2–38.7) to the total cartilage length. For the facet ratio there was no statistically significant gender difference ($p = 0.9363$). Intra- and interobserver reliability was good with intraclass correlation coefficients of 0.88–0.93 for the trochlear depth and 0.75–0.91 for the facet ratio.
Conclusion: This study for the first time provides data on important landmarks for deepening trochleoplasty based on average MRI measurements in the general population. The results may prove helpful for the surgical procedure. Further evaluation of these landmarks by prospective performing deepening trochleoplasty will determine the value of the clinical implication.

Free communications X – Foot

FM132

Salvage Arthrodesis after Failed Total Ankle Replacement vs Primary Ankle Arthrodesis in Endstage Osteoarthritis – A Matched Case Control Study

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Background: Salvage of a failed total ankle replacement (TAR) still remains a challenge. The conversion into arthrodesis represents a valuable solution with varying results in the literature. The question whether salvage arthrodesis would perform similarly to primary ankle arthrodesis has not yet been answered. The purpose of the current study is to compare the clinical and radiographic results of primary ankle arthrodesis with those obtained after salvage arthrodesis after failed TAR.
Methods: Twenty-three patients who underwent salvage arthrodesis after failed TAR (group SA) were matched with 23 patients who had had primary ankle arthrodesis (group PA) due to symptomatic end-stage ankle arthritis. Statistical matching has been done according to age, indication, nicotine abuse and fusion type. The data (clinical outcome, radiographic union and complications) was retrospectively analyzed.
Results: The follow-up time averaged 30 (range 10 to 92) months in group SA and 56 (range 23 to 94) months in group PA. Significant better results were found in group PA. The SF-36 scores in group SA averaged 47 (range 7–80) points and in group PA 66 (range 14–96; $p = 0.004$) points. The Foot Function Index (FFI; a score with the least pain and the best function when 0%) in the pain section averaged 57% (range 22 to 82) in group SA and 33% (range 0 to 88) in group PA ($p = 0.003$). The results for the FFI function section averaged 67% (range 42 to 98) in group SA and 48% (range 1 to 92) in group PA

(p = 0.015). A union rate of 74% (17/23 patients) was found in group SA after a mean time of 51 (range 13 to 106) weeks. The six patients suffering from nonunion received several revision operations and had persistent pain and bad function. In group PA 70% (16/23 patients) achieved a union after a mean time of 23 weeks (range 8 to 115) while three patients had painfree fibrotic nonunion and four needed revision surgery and all but one had a good to very good result. The overall reoperation rate (hardware removal not included) was 48% (11 patients with 35 operations) in group SA and 30% (7 patients with 12 operations) in group PA.
Conclusion: When compared with primary ankle arthrodesis salvage arthrodesis after TAR shows similar union rates but significantly higher revision rates and unsatisfactory overall clinical outcomes. In the light of the results obtained with the current study the opinion that failed TAR can always be salvaged easily by means of arthrodesis must be questioned.

FM133

Hintegra Total Ankle Joint Contact Pressures are Sensitive to Misalignment in Version

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Introduction: Mobile bearing total ankle replacement (TAR) can reduce the sensitivity of joint contact pressures to implant position. This is of high importance, since surgical misalignment may be a major cause in premature ankle implant failures. While numerous TAR designs have been suggested, objective comparisons of the various design approaches are lacking. In this study we investigated the highly congruent prismatic design of the Hintegra TAR and compared it against results from our previous study of the DePuy Mobility, which features a condylar shaped joint surface. Sensitivity of joint contact pressures to component misalignment in version was quantified using both experiments and finite element analysis.
Methods: A comprehensive parametric study was performed by successively varying implant positioning parameters within a finite element model of the Hintegra prosthesis. Static load cases were simulated for ankle positions seen at heel strike, mid-stance and toe-off, under an axial force of 800N. The results of the computer modelswere validated experimentally using actual implants loaded in a uniaxial testing machine to reproduce the simulated positions. Here, pressure distributions at the implant contact surfaces were measured using interfacial contact pressure sensors.
Results: In the manufacture recommended position for implantation, average Hintegra joint contact pressures were lower than thresholds associated with premature polyethylene wear. In contrast to the Mobility TAR, Hintegra joint contact pressures exceeded these thresholds with one degree of version misalignment. Differences between the two systems were more pronounced (more than 50% difference in average joint contact pressure) in 2 degrees of version. Thus, while the Hintegra implant system yielded smaller contact pressures than the Mobility TAR in a neutral position, edge loading of the Hintegra design was more severe than the Mobility, leading to higher average joint contact pressures in all tested version positions.
Conclusions: Although both considered prostheses represent three component, mobile bearing total ankle designs, they nonetheless responded differently to misalignment in version. The Hintegra total ankle joint contact pressures showed higher sensitivity to version than the Mobility. This implies that the design plays a key role in terms of contact pressure sensitivity to misalignment. As a consequence, special care must be given to the positioning of the implant independent of the design.

FM134

Thrombembolic Complications After Total Ankle Replacement: Systematic Literature Review and Our Results in 964 Total Ankle Arthroplasties

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Introduction: Total ankle replacement is becoming an increasingly used treatment for patients with degenerative arthritis of the ankle. However, there is limited literature addressing the incidence of thrombembolic complications after total ankle replacement. Therefore we performed a systematic literature review addressing thrombosis prophylaxis and incidence of thrombembolic complications after total ankle replacement. Furthermore we evaluated the incidence of thrombembolic complications in our clinic.
Methods: A systemic literature review was performed using established medicine literature data bases: MEDLINE®, Cochrane, Embase™, CINAHL®, ScienceDirect®, and SpringerLink. Following information has been extracted from the literature: 1) method and 2) duration of thrombosis prophylaxis, and 3) deep vein thrombosis/ pulmonary embolism as postoperative complication. The incidence of thrombembolic complications has been evaluated in our patient cohort including 964 total ankle replacements performed between 2000 and 2009 using a three-component total ankle arthroplasty. Deep vein thrombosis has been clinically diagnosed based on Wells-score of ≥1 and using duplex color Doppler ultrasonography.
Results: A total of 28 clinical studies performed between 1977 and 2012 have been included into the systemic literature review. 11 studies were prospective. Most studies were evidence level IV studies (21 of 28). The medial of included total ankle arthroplasties was 52 with a range between 10 and 701. In most studies (25 of 28) 3-component total ankle design has been used. In 20 of 28 studies the method of thrombembolic prophylaxis has been described. The range of the incidence of thrombembolic complications was between 0.0% and 9.8% with a median value of 0.0%. In our patient cohort including 964 consecutive total ankle arthroplasties the incidence of symptomatic deep vein thrombosis was 3.4%. There were no cases of pulmonary embolism. All patients received low-molecular-weight heparin prophylaxis.
Conclusion: The incidence of symptomatic deep vein thrombosis reported in the current literature is comparable to that in patients undergoing total hip or knee replacement. The incidence of thrombembolic complications in our patient cohort was comparable to that of symptomatic deep vein thrombosis in patients undergoing total knee or hip replacement or ankle fusion. We suggest prophylaxis using low-molecular-weight heparin in patients with total ankle replacement.

FM135

Effects of Unilateral Ankle Arthrodesis and Total Ankle Replacement on Gait Mechanics of the Contralateral Foot

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Introduction: Gait analysis is used to assess the outcome of ankle arthrodesis (AA) versus total ankle replacement (TAR) and several studies reported better outcome in TAR. The method of assessment often compared the operated foot with the control population, hence focusing only on the operated foot. In this study the outcome of AA and TAR is compared based on the achievement of gait symmetry.
Methods: Intra-subject gait analysis was performed to assess the symmetry between the operated and unoperated foot, 2–9 years post-operatively, for both AA and TAR patients. A healthy population (controls) was involved to define the normal gait symmetry. The study involved 36 participants, including 12 AA patients, 12 TAR patients and 12 controls. Gait Assessment was performed using ambulatory pressure insoles (Pedar-X, novel, DE) and inertial measurement unit (IMU) (Physilog, BioAGM, CH), mounted on the shank, hindfoot, midfoot and great toe. Participants performed a 50 m walking trial, twice, at a normal walking pace. Gait data were analyzed using the algorithms validated at the EPFL (LMAM). Mean, median, standard deviation (STD) and interquartile range of each measured parameter were calculated over the two trials for each foot and compared using the Wilcoxon signed-rank test ($p < 0.05$).
Results: Temporal-distance parameters: Operated side of AA showed significant difference with their unoperated side in stance (% gait cycle) and maximal load (% stance), compared to the other 2 groups. Kinematics: The AA group showed significantly lower range of motion (ROM) in all 3 planes at the ankle joint, sagittal and transverse planes of mid tarsal (MTL) joints and sagittal and coronal planes of metatarsophalangeal (MTP) joint. The TAR group presented almost symmetrical MTL ROM but significantly lower coronal motion was observed at ankle and sagittal motion at the MTP joint. The general tendency in both groups is a reduced ROM of all joints in the operated side compared to the unaffected side. Plantar pressure parameters: Significant asymmetry was seen in the unoperated side of the AA group in total contact duration (Tc), maximum pressure (Max P) and maximum force (Max F) in almost all foot regions. The TAR group showed a better symmetry, however the values were low compared with the controls.
Conclusion: AA patients retained a permanent residual effect from having an adaptive gait pattern, whereas TAR patients almost fully recovered, having similar results than the controls.

FM136

The influence of shoewear on functional outcome after Total ankle replacement and ankle-arthrodesis

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Introduction: Total ankle replacement (TAR) is endorsed in many studies because of possible superior subjective and functional outcomes over ankle fusion. However, due to cost (TAR ~ $5000, ankle fusion with 3–5 screws ~ $200), bone loss after trauma and indications (patient's age and co-morbidities), many ankle fusions are still being performed at the author's institution as well as in most countries around the world.
The functional outcome of total ankle replacement (TAR) or ankle arthrodesis (AA) is usually measured barefoot. However, this does not reflect the clinical reality, as we usually wear shoes. The purpose of this study was to evaluate the influence of sport shoes and rocker bottom shoes on the functional outcome after TAR and AA.
Materials and Methods: We assessed 84 patients (TAR 28, AA 56) and 35 healthy volunteers with dynamic pedobarography (Novel emed m/E, St. Paul, MN, USA) in three conditions: barefoot, sport shoes, rocker bottom shoes. Furthermore, AOFAS and SF36 scores, radiographs, comorbidities and postoperative complications were recorded after a minimum follow up of 2 years (average: 4.1,range: 2–6 years).
Results: The AOFAS- and all components of the SF-36-score were equal in both groups as was ASA and Charlson co-morbidity score. Post-operative complication rate was 7% for TAR and 3% for ankle fusions. Long-term complication for TAR was 11% (chronic pain 2, PE wear and osteolysis 1) and 16% for ankle fusions (symptomatic subtalar osteoarthritis 3, nonunion 3, osteomyelitis 1, peroneal tendon tear 1, chronic pain 1, malunion 1). Walking speed and total contact time were consistent either bare feet or with shoes. However, there was a significantly decreased contact time in the forefoot from 84% in bare feet to 77% wearing shoes and COP velocity increased from 0.3 m/s to 0.37 m/s. Maximum pressures and forces as well as pressure-/force-time-integrals in the forefoot did not differ. However ambulating in rocker-bottom shoes resulted in a significantly stronger push-off (~715 kPa) than wearing running shoes (~500kPa). Operated patients exhibited approximately 20% decrease in walking speed or contact times compared to healthy subjects.
Conclusion: In shoes TAR and AA have the same functional results. The inferiority of AA compared to TAR is not measurable. We conclude that ankle arthrodesis and Total Ankle Replacment are equal operations regarding functional outcome.

FM137

Stress fracture of the malleolus medialis after implantation of an ankle prosthesis

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Background: Stress fracture of the malleolus medialis is a complication, which can occur after implantation of an ankle prosthesis. Purpose of this study was to analyze this complication in a consecutive serie of total ankle arthroplasty (TAA).
Methods: A consecutive serie of TAA using one single design (Mobility™) in one single center has been reviewed retrospectively regarding any radiological evidence for fracture of the malleolus medialis on standardized X-rays (weight bearing, dp and lateral views) routinely performed intraoperatively, 6 weeks, 12 and 24 months postoperatively or in case of clinical suspicion for a stress fracture.
Results: Between 2003 and 2009, 323 TAA have been implanted in 323 patients. Mean age at the time of surgery was 62 (27–87) years, 160 (49.5%) patients were females, 163 (50.5%) males. 199 (61.6%) TAA were implanted on the right side, 124 (38.4%) on the left side. Stress fractures have been detected in 19 (5.9%) ankles at an average postoperative time of 24 (5–104) weeks. None of those fracture showed a serious displacement. The fracture lines were in 12 (63%) vertical, in 5 (32%) cases horizontal and in 1 (5%) case diagonal. The bridge tibial component (TC) – malleolus medialis cortex (MMC) is the distance measured between TC and MMC was in fracture group 10.77 mm (6.5 to 14.7) and 12.57 mm (4.8 to 18.5) in non-fracture group. The fracture incidence was 3 x higher in females (13 (70%)) with a significant higher mean age in comparison to the male population (67.9 versus 61.3 years). The body weight was higher in the fracture group (mean 79 kg versus 72 kg). All fractures healed uneventfully, for 9 (47.37%) patients without specific treatment, for 5 (26%) under protection of a walker and partial weight bearing and for 5 (26%) after ORIF with 2 percutaneous screws. Patient with screw fixation had a less good ROM after 1 year 20.18° compared with the group without any treatment 23.74°.
Conclusion: Stress fractures of the malleolus medialis can occur after TAA implantation. Since those fractures were found more frequently in females, heavier patients, and with small bridge TC-MMC in our serie, so less aggressive postoperative regime for this population might reduce their incidence. Stress fractures can heal without specific treatment. ORIF of this medial malleolus fracture does not seem to improve the ankle ROM.

FM138

Bone Augmentation for Revision Total Ankle Arthroplasty with Large Bone Defects: Treatment Algorithm and Outcome

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Introduction: Revision surgery after a failed total ankle arthroplasty (TAA) may become challenging due to extensive bone loss, poor soft tissues, and hindfoot pathologies. Revision ankle arthrodesis may result in substantial shortening of the lower extremity and impaired functional results. With the availability of a wide spectrum of implants, however, revision arthroplasty may become a viable alternative. The study presents a treatment algorithm for revision TAA with bone augmentation, and revision implants in patients with aseptic loosening of ankle prosthesis associated with large bone defects.
Methods: There were 4 male and 6 female patients with a mean age of 51.7 years (range, 29–71 years) who underwent revision TAA due to aseptic loosening of TAA associated with extensive bone loss. We used iliac crest autografts depending on size, localisation, and configuration of bone loss. Pre- and postoperatively, x-rays and/or CT-scans were analysed and the patients were evaluated clinically including the AOFAS ankle score, visual analogue scale for pain (VAS, 0-10), range of motion (ROM), ankle stability, and ability of daily life activities. Intra- and postoperative complications were recorded. The mean follow-up was 47 months (range, 24–62 months).
Results: One ankle in a patient with chronic pain syndrome had to be converted into an arthrodesis. The AOFAS ankle score for the remaining patients significantly increased from 39 points (range, 18–56) to 83 points (range, 70–97; $p < 0.05$). The VAS for pain significantly improved from 6.0 (range, 5–8) to 1.0 (range, 0–3; $p < 0.05$). The postoperative ROM of the ankle joint was in average 24.4° for flexion (range, 10–30°) and 4.4° for extension (range, -10-15°). Two patients underwent arthrolysis and ossification removal. Postoperative radiographs showed stable integration of iliac bone blocks and no loosening signs around prosthesis components.
Discussion: Revision TAA with structural bone augmentation according to the proposed treatment algorithm shows to be a viable treatment option in the armamentarium of revision surgery for failed TAA with aseptic loosening associated with large bone defects. Cases have to be carefully selected and preoperative planning is crucial. Further clinical studies are needed to address the long-term results of this procedure.

FM139

Isolated Tension-Bending Fusion for Stage 3 and 4 Muller-Weiss Syndrome

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Summary: With this prospective study we illustrate that an isolated talonavicular fusion is a highly effective solution in the treatment of stage 3 to 4 of Muller-Weiss syndrome (MWS).
Introduction: In MWS there is evidence of progressive avascular necrosis of lateral aspect of navicular. MWS is a progressive destruction of the navicular that starts with a collapse (stage 2), to get fractured (stage 3) and later on fragmented with expulsion of its dorso-lateral flake (stage 4). Complete collapse occurs in stage 5. Most patients seen by orthopedic surgeons suffer from a MWS stage 3 or 4. There are still controversies with regard to the surgical approach for reconstruction. Most authors advocate fusion of the subtalar (ST) and naviculo-cuneiform (NC) joints in order to achieve reliable healing. As by this procedure delayed or non-unions of the NC joint are observed, we started to perform isolated talonavicular (TN) fusion. The purpose of this study was to assess 1) the effectiveness of the strategy and 2) to assess the radiological and clinical outcome.
Method: There were 2 male and 8 female patients with a mean age of 63.5 years. All patients presented with a painful deformity with its apex at TN joint. The standard X-rays showed a talar head that was externally rotated and impacted into the collapsed navicular, a medialized navicular and bony fragmentation at dorso-lateral aspect of navicular. The TN joint was exposed through a medial approach. After debridement, a second incision at lateral aspect of TN joint was done to remove the avascular fragments and to further debride lateral aspect. The navicular was reduced with regard to talar head and an Uni-CP staple was used to fix the TN joint on its lateral part first, acting as a tension bending. Two other screws were used to accomplish further stability. A scotch plaster was used to immobilize the foot for 8 weeks. Weight-bearing was permitted after 2 weeks.

Results: At 8 weeks, solid fusion at arthrodesis site was found in all but 2 cases. In those 2 cases, fusion was achieved after 12 weeks, as confirmed by CT scan. All patients were satisfied with the obtained result.
Conclusion: The tension bending technique from lateral side is an efficient and successful method to get a stable construct for a TN arthrodesis in MWS. With the obtained results in this preliminary series of 10 feet, we continue to consider this isolated TN fusion technique as sufficient for treatment of patients with stage 3 and stage 4 MWS.

FM140

Quantitative evaluation of the cartilage height using high-resolution MRI of the talocrural articulation from non-, recreational- and professional athletes

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Keywords: Cartilage, squad Athletes, MRI, Ankle
Purpose: To evaluate the cartilage height at 20 Non-, 35 Recreational- and 40 squad athletes by MRI, in the age of 16 to 56 years and training/week with 0 h/week for Non athletes, 2–10 h/week for recreational athletes and 7–22 h/week for professional athletes.
Material und methods: The professional athletes are in the squad A, B and C from the German National Olympic Committee (DOSB) from the sport table tennis, badminton, hockey and Volleyball. The examinations were performed used a 1,5 Tesla MRI (Sonata, Siemens) (FLASH-3D-sequence in sagittal and coronal orientation). The bilateral measurement of the cartilage is based on the evaluation of the volume of tibia and talus is cut into 9 areas, sectional in the coronal level in anterior, intermediate and posterior portion, and in the sagittal level in medial, intermediate and lateral portion.
Results: The evaluation of the cartilage height proved that athletes had a higher cartilage in the talocrural articulation than the non-athletes. Professional athletes had an average height in the main area of the cartilage with 3,31 mm (min. 2,73 mm – max. 4,26 mm), recreational athletes 3,14 mm (min. 2,20 mm – max. 4,49 mm) and non-athletes 2,75 mm (min. 2,21 mm – max. 3,15 mm).There were differences until to 19% in the cartilage height between both sides in groups of table tennis and badminton. The cartilage of the ankle on the same side from the racket holding arm was in most cases higher than his counterpart. Non-athletes had a sharp border between cartilage and bone, for the recreational- and professional athletes presented this border unsharp. No abrasion in the main area of exposure in athlete's cartilage was seen similar to the non-athletes.
Conclusion: Sportive activity has a positive benefit of the cartilage volume and height in the talocrural articulation. There was no abrasion in the main area of exposure in the group of athletes. Cartilage-bone-border is unsharp by athletes, by non-athletes sharp.

FM141

Limited open reduction of displaced intra-articular calcaneal fractures – 12 years experience with minimum 2 year follow-up

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Purpose: A limited open technique to treat displaced intra-articular calcaneal fractures was used since 1998, and exclusively since 2002 in our institution. Its equivalence in ultimate function was shown in a single surgeon study against a control group of lateral plating via extensile approach. The aim of this study was to assess its results with multiple surgeons of the same institution over 10 years.
Method: Hundred and nineteen patients were treated for isolated intraarticular calcaneal fractures with a Sanders classification II to IV from 1999 to 2004. The study group included 78 patients with 81 fractures, of those 61 had intraarticular calcaneal fractures Sanders classification type II, 26 type III, and five type IV. Thirty-four patients with additional fractures of the talus, luxation fractures, non-operative treatment, and primary arthrodeses were excluded. Seven patients were lost for follow-up. At minimum follow-up of two years patients were assessed clinically and radiographically, the functional outcome was evaluated by the AOFAS ankle hindfoot score.
Results: The average follow-up was 34 months, SD 22.5, average age 41.9, SD 12.7. The average hospital stay was 13.5 days, average time to union 3.1 months; SD 0.38. Four patients had delayed wound healing requiring debridment and irrigation but healed without any further complications. Further complications were a traction of the medial neurovascular bundle in one patient that was successfully treated by an open neurolysis and slight to severe CRPS' in four patients. Thirty-eight patients claimed at least a partial implant removal (mostly of the tuberosity screws). At latest follow-up average AOFAS score was 84.4, SD 14.3. Average subtalar motion was 37% of the healthy contralateral side. On the radiographs the postoperative average Böhler-angle measured 30.6°, SD 7.3°. Twenty-eight (22.7%) subtalar joints presented at least some degree of posttraumatic arthritis, whereas four patients needed a subtalar fusion (Sanders type II: 1; III: 2, IV: 1).
Conclusion: The overall functional results remain good, comparable to other large series. The advantages of the limited approach – less operative time, less wound healing problems – are maintained. This technique can successfully be taught and practiced in a single institution.

FM142

Arthroscopically assisted mini-invasive fracture treatment of Hawkins Type I talar fractures

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Summary: Arthroscopically assisted mini-invasive reduction and internal fixation (ORIF) of Hawkins Type I fractures of the talus is a safe technique that allows anatomic reduction of the fracture and early mobilisation thus Hawkins Type I fractures result in an excellent functional outcome.
Introduction: Important challenge with Hawkins Type I fractures of the talus is ensuring that anatomic reduction is obtained with no varus rotation. Surgical treatment is often conflicting with regard to exposure and ORIF. Extended approach or an additional second approach may result in damages of the surrounding soft tissues which may compromise the functional outcome and increase the risk of avascular necrosis (AVN) of the talus. We thus started to use an arthroscopically assisted mini-invasive approach. The purpose of this preliminary work is 1) to describe the technique, 2) to assess the obtained result by CT scan and 3) to determine the clinical outcome.
Methods: A consecutive series of 4 patients (females, 2; males, 2; mean age 41.5 [24–61] years) were included. The mean time between diagnosis and treatment was 21 days. A 4 mm arthroscope was used through an anterior central portal. A 2.5 mm K-wire was inserted percutaneously from medially into the talar head and a second one into the talar body just along the anterior border of the medial malleolus. A Hintermann distractor was mounted and then carefully distracted to open the fracture under arthroscopic visualization. The fracture was then reduced while using the K-wires as joy-sticks. A 1.5 mm K-wire was inserted under fluoroscopic control from the supero-lateral edge of the talar head, and a second one from the supero-medial edge of the talar head into the talar body, aiming to reach its posterior part just above the subtalar joint. A 5.5 mm screw was inserted over each of the two K-wires. In the case of intermediate fragments a fully threaded screw was used; otherwise, a compression screw was inserted. Final reduction was checked arthroscopically at the tibiotalar joint and, using an additional portal through sinus tarsi, at the subtalar joint. If an additional fracture of the processus lateralis tali was present, reduction was obtained by manual manipulation or using a hook and fixation was achieved by a cannulated 3.0 mm screw. CT scan was performed as postoperative control. The foot was protected by a walker during 8 weeks, starting with partial weight-bearing for the first 4 weeks and full weight-bearing thereafter. Continuous passive motion was used during these 8 weeks. Fracture healing was assessed radiographically after 8 weeks, 4 months and 12 months.
Results: Anatomic reduction and stable fixation was obtained in all four cases. All fractures healed within 8 weeks and there were no signs of AVN in any case. All patients were highly satisfied with the results obtained and showed functional outcome similar to the contralateral foot.
Conclusion: Arthroscopically assisted, mini-invasive reduction and fixation of Hawkin Type I fractures yielded in excellent early results. As we see a main benefit in minimizing additional damages to the soft tissues, thereby also minimizing the risk of AVN, we continue to use this technique in the future.

FM143

Corrective supramalleolar osteotomy in malunited pronation-external rotation fractures of the ankle joint

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Introduction: After fractures of the ankle joint – besides cartilaginal damages and soft tissue problems – the congruency and the position of the articulating bones are crucial to the further healing progress. A posttraumatic malalignment after pronation-external rotation-fractures often results in degenerative changes of the ankle joint due to the asymmetrical load distribution. Malunited fractures of this type show a valgus deformity of the joint surface of the distal tibia which is often accompanied by a shortening or a malrotation of the fibula. The objective of this study is to analyze the results after corrective supramalleolar osteotomies of the tibia and the fibula.
Methods: Between 1995 and 2008 48 Patients (25 female, 23 male, mean age 45 years (21–69 years)) who had a malposition of the ankle after a pronation-external rotation fracture were treated by a

supramalleolar osteotomy of the tibia and the fibula. The fracture type was weber type C in 43 cases (8 of them maisonneuve type) and type B in 5 cases. The mean time interval between the trauma and the corrective surgery was 20.2 (3–98) months. The correction of the tibia was either performed by means of a medial closing wedge osteotomy or of a lateral opening wedge osteotomy with interposition of an allograft. The correction of the fibula was performed by the use of an oblique osteotomy that was fixed by a 6-hole-plate with locking screws. During a postoperative period of 8 weeks an immobilization of the ankle in a splinting vacuum boot with only partial weight bearing was arranged. The patients were reassessed in regular clinical and radiological follow up-examinations including a survey of the range of motion and of the stability of the joint. In addition the AOFAS-Score was assessed. The radiological examinations were evaluated according to Takakura's classification.
Results: A medial closing wedge osteotomy was conducted in 45 cases, and an intraarticular lateral opening wedge osteotomy in 3 cases to correct the tibia. To achieve a neutral position of the hindfoot there was additionally performed a corrective procedure of the calcaneus in 19 cases (16 medial sliding osteotomies and 3 lateral lengthening osteotomies). The mean corrective angle of the joint surface of the distal tibia was 5.2°, which resulted in a postoperative valgus position of 2.8°. A complete osseous consolidation of the tibia was seen after a mean of 2.4 months, in 2 cases a delayed consolidation occurred after 6 respectively 7 months. After 7.1 (2–15) years 42 of the patients were satisfied or very satisfied. 41 patients were completely free of complaints. The mean value of the AOFAS-Score was 86 (64–100) points. In 1 case a total ankle replacement was implanted after 26 months due to persisting pain and progressive osteoarthritis. Radiologically there was seen no increase of the degenerative changes in 30 cases, moderate increase of the degenerative changes in 14 cases and advanced increase of the degenerative changes in 3 cases.
Discussion: The results show that malunited pronation and external rotation fractures can successfully be treated by a corrective supramalleolar osteotomy. Osseous balancing of the hindfoot is essential to prevent degenerative changes of the ankle joint.

FM144

Peritalar Dislocation after Tibiotalar Arthrodesis – Fact or Fiction?

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Summary: This prospective observational study present three patients with substantial peritalar dislocation after isolated tibiotalar arthrodesis.
Introduction: Arthrodesis of tibiotalar (ankle) joint is still considered the golden standard for treatment of the end-stage osteoarthritis associated with difficult conditions such as unmanageable misalignment and instability. In this context, many surgeons may consider isolated tibiotalar arthrodesis for the unstable ankle with severe valgus deformity where the medial ligament complex has become incompetent, as seen typically in the stage IV posterior tibial tendon (PTT) dysfunction. The idea behind this procedure is to stabilize the talus within the ankle mortise, and to compensate the loss of motion in the sagittal plane at peritalar joints which are typically unstable due to inefficient ligaments. However, whether increased mechanical load of peritalar joints can further destabilize the hindfoot is not known. Most recently, we have seen 3 patients after an isolated tibiotalar fusion for treatment of a valgus unstable osteoarthritic ankle presenting a peritalar dislocation beneath the successfully healed tibiotalar fusion. This complication after tibiotalar fusion has, to our knowledge, not been reported in the literature yet. The purpose of this paper was therefore 1) to present these case series and 2) to assess the underlying causes that may be responsible for this unfavorable evolution.
Methods: This patient series included a 70 year-old male patient 28 years after isolated tibiotalar arthrodesis, a 55 year-old male patient 3 years after tibiotalar and calcaneocuboid arthrodesis, and a 72 year-old male patient 1.2 year after isolated tibiotalar arthrodesis. Preoperatively, all patients presented a valgus osteoarthritic ankle associated to a flatfoot deformity (stage IV PTT dysfunction), with a valgus tilt of 12°, 14°, and 13° within the mortise.
Results: All patients reported a progressive destabilization of the hindfoot complex into valgus and pronation with flattening of the arch, and free ambulation has become impossible despite of wearing orthopedic shoes. There was a substantial valgus misalignment of the hindfoot, with lateral offset of 54 mm, 16 mm, and 40 mm in the Saltzman alignment view. Tibiotalar fusion was achieved in all patients with a remaining valgus position of the talus of 4°, 6° and 5°, respectively. The talus was slipped medially, and the fibula was pressed into lateral wall of tilted calcaneus. In two patients, the talar head was dislocated completely towards medially. No patients showed evidence of entrapment of tibial nerve.
Conclusions: Although not common, peritalar dislocation can potentially result from tibiotalar fusion of a valgus unstable hindfoot as typically the case for stage IV PTT dysfunction. The inefficient peritalar ligaments may not be able to withstand the increased mechanical load. This may be particularly true for the fused tibiotalar joint in valgus, e.g. where the talar position was not corrected to neutral position. This may increase the translational forces, with slipping of talus on calcaneus towards medially. Tibiotalar fusion should thus be indicated with caution in the valgus unstable osteoarthric ankle; if so, special attention should be paid to achieve fusion of talus within the ankle mortise in a neutral position.

FM145

Safe Zones for Percutaneous Pin Placement in the Calcaneus

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Introduction: Placement of a percutaneous pin in the calcaneus is indicated in various conditions. Electively, these include ankle and subtalar distraction, ankle arthrodesis and correction of deformities. Transcalcaneal pins are often used in reduction or in combination with external fixation to stablise dislocated ankle fractures or pilon fractures. Depending on the indication, one or more pins may be used. Neural structures are at risk during this procedure, medially the tibial nerve and laterally the sural nerve and their branches to the calcaneus. There is no consensus in the literature as to how or where the pins should be placed. The purpose of the following study was to reveal if there is a safe zone for transcalcaneal pin placement with special emphasis on neural structures. If a safe zone was identified a further goal was to develop a visual tool to be used during surgery to reliably identify safe pin direction.
Methods: Eighteen Thiel-fixed cadaveric below knee lower extremities were used for the study. Dissection was performed to identify and measure all neural structures in relation to the calcaneus. All dissected nerve branches were labelled with radiological colour and fixated. A lateral radiograph of each calcaneus with overlying nerves was obtained. All radiographs were printed from both the medial and lateral sides. The images were scanned and zoomed to a uniform size. Within each section of the calcaneus the frequency of nerve strikes were counted and marked on a scaled "Map of Neural Frequency". The results from this map have been used as a basis to generate a three-dimensional model of the calcaneus with marked safe zones for calcaneal pinning.
Results: The area for safe pin placement at the calcaneus is restricted to a narrow band dorsal of the calcaneal tuberosity. Medially this band widens proximally (close to the insertion of the achilles tendon), and laterally it widens distally until the lateral calcaneal process.
Conclusion: Compared to other studies, the safe zones for calcaneal pinning are significantly smaller than described. Conventional pinning techniques risk damaging important neural structures. Consequently these results indicate a direction of pin placement that differs from previous investigations, whereby the insertion of the achilles tendon and the lateral calcaneal process corresponds to a reliable landmark.

FM146

dGEMRIC of Cartilage After AMIC – Aided Reconstruction of Osteochondral Lesions of the Talus

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Purpose: To assess the cartilage quality after repair of osteochondral lesions of the ankle joint with autologous matrix induced chondrogenesis (AMIC) using delayed gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC).
Materials and methods: A 3D SGE sequence at 3T was used to obtain quantitative T1 values before and after Gd-DTPA2- (Magnevist, 0.2 mM/kg) application to assess 23 cases after AMIC-aided repair of osteochondral lesions of the talus. Delta relaxation rates (ΔR1) for reference cartilage (RC) and repair tissue (RT), and the relative delta relaxation rate (rΔR1) were calculated. Morphologic appearance of the cartilage RT was graded on sagittal DESS views according to the MOCART protocol. The study as approved by the IRB. Written patient consent was obtained.
Results: The AMIC cases had a precontrast mean T1 of 1.194 s (SD 0.207 s) in RC and 1.470 s (SD 0.384 s) in RT. Postcontrast T1 decreased to 0.480 s (SD 0.114 s) in RC and 0.411 s (SD 0.096 s) in RT. There was a significant difference ($p > 0.05$) between the ΔR1 in RC (1.372 x 10-3 s-1, range 0.526-3.201 x 10-3 s-1, SD 0.666 x 10-3

s-1) and RT (1.856 x 10-3 s-1, range 0.93-3.336 x 10-3 s-1, SD 0.609 x 10-3 s-1). The mean rΔR1 was 1.49 SD 0.45). The mean MOCART score at followup was 62.6 points (range 30-95, SD 15.3).
Conclusion: AMIC-repair in the ankle yields repair tissue with GAG content differing from healthy hyaline cartilage. However, cartilage quality is comparable to other established cartilage repair techniques.

FM147

Twenty-year outcome after surgical treatment of midtarsal joint injuries

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Introduction: Complex midtarsal (Lisfranc) fracture-dislocation is a challenging injury, characterized by loss of contact of the midfoot bones as well as fracture of one or more bones surrounding the Lisfranc ligament. The principle of treatment of such injuries involves stable fixation of fractures, anatomical reduction of the displaced midtarsal bones with temporary or permanent arthrodesis to maintain their position. The aim of our study was to evaluate the functional, clinical and radiological outcome of patients managed surgically during the last twenty years at our institution.
Materials and Methods: Medical charts were analyzed retrospectively of all patients operated upon between 1988 and 2009. Clinical outcomes were assessed with the American Orthopaedic Foot and Ankle Society (AOFAS) midfoot score, Musculoskeletal Function Assessment (MFA) score, Foot Function Index (FFI) score, the Short Form-12 Health survey. We also recorded concomitant/additional surgical procedures, and performed radiological evaluation.
Results: Of the 144 patients operated upon, 62 (mean age 51 years, 75% men) were available for FU. Patients underwent in general an open reduction and internal fixation (ORIF) with temporally/permanent arthrodesis. Mean follow-up was 132 months (range 30–292). Mean functional outcome scores were: 79.7 (47 to 100) on the (AOFAS) midfoot score, 18 on MFA score, 16.8 (range 8.3 to 40.0) on FFI score and a relative good quality of life (49 on SF-12). Radiographic analysis revealed good alignment on anteroposterior and lateral weight-bearing radiographs in 55 patients (84.6%). Symptomatic posttraumatic arthritis was present at FU in 44 patients (70.97%). Patients who had undergone permanent arthrodesis either as primary or as additional surgery showed better clinical results.
Conclusions: According to the scientific literature, an acceptable outcome depends on achieving and maintaining a well-aligned and well-reduced joint. Primary arthrodesis may lead to better short term functional outcome.

FM148

The radiological position of the talus after a supramalleolar osteotmoy in varus tilted ankle

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Summary: This radiological study present the results after a supramalleolar osteotomy of the 3D Talar position in 55 varus tilted ankle.
Introduction: The goal of supramalleolar osteotomy in varus ankle is to realign the hindfoot and to unload the overstressed medial part of the ankle joint. This surgery has already shown to improve clinical function and radiological signs of ankle arthritis. The radiological measurement results of the plafond tibia and the hindfoot alignement on the frontal plane are significantly well corrected. Instead of additionals procedures, the frontal position of talus remain sometimes unless corrected and still tilted. Nosewicz and al. have demonstrated on varus-tilted ankle that the talus was also endorotated in the transversal plane and dorsiflexed in the sagittal plane. Little is known about the effect on the talar position after a supramalleolar osteotomy. The hypothesis is that (1) the correction of frontal alignement of the ankle has also an effect on the talar position in 3D and (2) patients with insufficient correction of the talar tilt have also sagittal or horizontal misalignment already present.
Material and Methods: Between 2006 and 2012, 55 consecutive patients (age 54 years, range 27–74) with a varus-tilted ankle of more than 5° underwent a correcting oeteotomy at our institution. Weight-bearing radiographs (mortise ankle view, lateral, AP-view and Saltzmann view of the foot) were used to assess the 3D radiological of the talus pre- and postoperatively. Patients with neurological disorders, or additionals procedures distal to the ankle (subtalar fusion, calcaneum osteotomy) were excluded. 50 cases were corrected with a medial opening wedge and 5 cases with a lateral closing wedge. The congruency of the ankle joint was restored with fibula shortheninng osteotomies in 14 cases. Radiographs were analysed pre- and postoperatively to measure the alignment and the 3D position of the talus with the talar tilt (TT) (according to the difference between the talar dome and the tibial-ankle surface angle (TAS)) on the mortise view. The position of the talus on the lateral view was determined measuring the sagittal talocalcaneal inclination angle (TCI). In the horizontal plane the rotation of the talus was assess with the talometatarsal 1 angle (TMT1). Calcaneum offset was assessed using the saltzmann view. Sagittal and horizontal data were compared with a normal cohort. The neutral position was defined within two standard deviations of the mean of the control group (30.5° (SD = 4.5) for TCI and 3.7° (SD = 7.9) for TMT1).
Results: The mean preoperative measurement was TTA = 74.9° (SD = 5.7); TT = 11.5° (5.9) on the frontal view; TLS = 81.9° (4.1), TCI = 17.8° (7.4) on the lateral view; TMT1 = 8.8° (14,1°) on the dorsoplantar view; calcaneum offset = 26.1 mm (11.1). At one year a statistical difference was found between the preoperative and postoperative results for the calcaneum offset, the TTA, TCI ($P < 0.05$). The mean postoperative measurement was TTA = 82.5° (5.9); TCI = 21.4° (7.1); Calcaneum offset = 11.8 mm (10.6). No statisticals differences were found for the TT and TMT1 between pre and postoperative.The mean postoperative measurement was TT = 9.7° (5.1); TMT1 = 8.5 (11.6).
Discussion: In this study the 3D position of the talus preoperatively in varus tilted ankle was also malaligned in additionals planes, it was more dorsiflexed and endorotated than the normal cohort. The correction of the varus tilted ankle deformity by a supramalleolar osteotomy induces also a modification of the talus position on the lateral view but no statistical difference on the dorsoplantar view. The lack of correction of the endorotation on the horizontal view of the talus could be explained by a contracture of the medial structures. In conclusion the talus position in a varus-tilted ankle is also dorsiflexed and endorotated. Realignement correction of a varus deformity change also the coronal position of the talus, but the patients with a talar tilt still presents have also a lack of correction of the talar position in the horizontal plane. Further studies are necessary to elucidate if a complete correction of talar position is needed to have a balanced and congruent ankle joint.

Posters

P1

Anterior correction and fusion of the lumbar spine: The lateral approach with stand-alone cage interposition. Clinical outcome with a minimal one year follow up

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Introduction: The lateral approach to the lumbar spine offers an alternative for the treatment of degenerative deformities and instabilities. The standard technique consists in a combined anterior-posterior intervention. We started with the lateral approach using a stand-alone technique without posterior stabilization with the hypothesis that this approach is safe, and will lead to a solid fusion – reducing the surgical effort and consecutively be more cost effective.
Methods: Prospective case series. All patients that underwent a lateral lumbar spine intervention were prospectively followed using the spine tango questionnaire with the COMI back score preoperatively and the follow up controls at one, three, six and 12 months. In addition the radiological parameters were assessed (deformity correction – loss of correction / subsidence, fusion).
Results: The study includes 95 patients (25 male, 70 female). Average age is 68 y (42–84). Overall 179 levels have been treated, in average 1.9 levels per patient (1–5). The distribution of levels was L1-L2 = 20; L2-L3 = 58; L3-L4 = 61; L4-L5 = 40. The indication was a spinal instability (i.e. degen. slip) in 36 and a deformity in 59 patients. For fusion DBM was used in the 10 first patients, iliac crest was used in 63 and BMPII in 21 patients. Transient psoas weakness was present in 74% of patients one month postop and in 20% at three months – all approach related symptoms subsided after six months. Two patients did show a paresis if the abdominal wall on the side of the approach – one remained permanent. A severe paresis of the obturator N did occur in one patient that recovered incompletely after one year.
10 patients underwent a secondary posterior stabilization within the first three months after the index intervention. 7 patients got a

vertebroplasty within the first three weeks after the intervention due to a vertebral fracture and a cage subsidence. The back pain scale improved by 5.4 points at the one year FU, leg pain by 4.8 points; the COMI score improvement was 6.1 at one year (p <0.05).
Conclusion: The lateral approach offers a very efficient mean for the treatment of degenerative instabilities and deformities of the lumbar spine. The stand alone technique is working in 90% of cases – the routine use of an additional posterior stabilization is not required. The approach related morbidity is important in the early phase but is self-limiting within 6 months.

P2

Pedicle height to vertebral height ratio: an anatomical predisposition to symptomatic lumbar foraminal stenosis?

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Introduction: Symptomatic foraminal stenosis has been observed in patients with degenerative disc disease, scoliosis, asymetrical disc degeneration and spondylolisthesis. Nevertheless not all patients with the above pathologies will develop symptomatic foraminal stenosis. We hypothesised that symptomatic patients have anatomical predisposition to foraminal stenosis, namely a larger pedicle height (PH) to vertebral height (VH) ratio, leaving less room below the pedicle for the exiting nerve root compared to asymptomatic patients.
Materiel and Methods: A total of 88 patients devided in two groups were included in this study: the surgical group was comprised of 58 patients (average age of 62 years) who presented with severe radicular symptoms resisting to conservative measures and who required decompression and transforaminal lumbar interbody fusion (TLIF). The control group was comprised of 28 patients (average age of 55 years) presenting with low back pain (LBP) but with no radicular symptoms and who were treated conservatively.
On both groups we measured vertebral body height (VH) at the level of the posterior wall as well as pedicle height (PH) on parasagital images (CT or MRI) of the lumbar spine using the Osirix imaging software. Measurements were performed on all lumbar levels from L1 to L5 and on both sides for each patient. Statistical analysis was performed using Student's t-test.
Results: The PH/VH ratio was larger in the symptomatic group treated surgically by TLIF than in the LBP control group for all lumbar levels analysed together (p <0.001).
The mean value for the ratio in L1 in the surgical group was 0.51 (SD 0.06), compared to 0.463 (SD 0.05) in the control group (p <0.001). At the L2 level, the ratio was of 0.49 (SD 0.05) and 0.47 (SD 0.06) for the surgical and LBP groups respectively (p = 0.02). At L3, the ratio was of 0.48 (SD 0.05) and 0.45 (SD 0.05) in the two respective groups (p <0.005). Althought for L4 this ratio was similar (0.46, p = 1), for L5 the difference was greater with a ratio of 0.48 (SD 0.06) in the surgical group and 0.46 in the LBP group (p <0.05).
Discussion: We found that symptomatic patients with foraminal stenosis have larger pedicles in the cranio-caudal direction in at least four out of the five levels studied when this measurement is normalised to the vertebral height. This is translated by a smaller space beneath the pedicle leaving the exiting nerve root more vulnerable to compression in case of spondylolisthesis or disc degeneration. This might explain why some patients probably are less prone to become symptomatic even in the presence of severe degeneration of the disc. In conclusion we believe that there are anatomical differences which predispose some patients to symptomatic foraminal stenosis.

P3

Cement-augmented anterior screw fixation of type II odontoid fractures. Description of a new technique to reduce the risk of secondary dislocation in elderly pa

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Introduction: Closed reduction and internal fixation by an anterior approach is an established option for operative treatment of displaced type II odontoid fractures. In elderly patients, however, inadequate screw purchase in osteoporotic bone can result in severe procedure-related complications. The purpose of this study was to improve the stability of odontoid fracture screw fixation in the elderly employing a new technique that includes injection of PMMA cement into the C2 body.
Methods: This study is a retrospective review of hospital and outpatient records as well as radiographs of twenty-four elderly patients (8 males, 16 females; mean age 81 years, range 62–98 years) with type II fractures of the dens. Post- and perioperative complications, cement leakage (symptomatic/asymptomatic), operation time, loss of reduction, pseudarthrosis and revision surgery, patient complaints, return to normal activities, and signs of neurological complications were documented.
After closed reduction and anterior approach to the inferior border of C2, a guide wire is advanced to the tip of the odontoid under biplanar fluoroscopic control. Prior to the insertion of 1 cannulated, self drilling, short thread screws, a 12 gauge Yamshidi cannula is inserted from anterior and 1–3 ml of high viscosity PMMA cement is injected into the anteroinferior portion of the C2 body. During polymerization of the cement, the screws are further inserted using a lag-screw compression technique. The cervical spine then is immobilized with a soft collar for 8 weeks postoperatively.
Results: Anatomical reduction of the dens was achieved in all 24 patients. Mean operative time was 64 minutes (40–90 min). Early loss of reduction occurred in 3 patients, but revision surgery was indicated in only one patient 2 days after primary surgery. One patient died within the first 8 postoperative weeks, one within 3 months after surgery. In 5 patients asymptomatic cement leakage was observed (into the C1-2 joint in 3 patients, into the fracture in 2). Conventional radiologic follow-up at 2 and 6 months confirmed anatomical healing in 16 of the19 patients with complete follow up. In 2 patients the fractures healed in slight dorsal angulation, one patient developed a asymptomatic pseudarthrosis. All patients were able to resume their pre-trauma level of activity.
Conclusion: Cement augmentation of the screw in type II odontoid fractures in elderly patients is technically feasible in a clinical setting without an increased relevant complication rate. This technique improves screw purchase, especially in the osteoporotic C2 body.

P4

Intra-abdominal migration of a gamma nail lag screw: A rare complication

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Introduction: Fractures of the proximal femur are common in the elderly population. Intra-medullary nailing has become the standard treatment for fractures in the trochanteric region. However there are a number of associated complications.
Case report: We report the case of a 69 year old female who presented medial migration of the lag screw into the pelvis at five and a half weeks postoperatively. Following the concepts in the literature, the nail was removed and replaced by THA after embolisation of one branch of the left internal iliac artery.
Discussion: A frequent complication of proximal femoral nailing is lag screw cut-out from the femoral head which is believed to occur in 2–8% of cases. The main causes are varus position of the femoral neck and eccentric position of the lag screw. Cut-out with intra-abdominal migration of the lag screw is very rare. There are only a few papers in the literature describing such cases. We carried out a thorough review of the literature and present this with analysis and discussion of our case. The contributing factors in this case are the fracture pattern, poor peroperative fracture reduction, a 'Tip Apex Distance' higher than 20 mm, an incorrectly placed anti-rotational screw and all of this compounded by osteoporotic bone. The literature reminds us the importance of ruling out intra-abdominal visceral and/or vascular injury as well as infectious process. In this case, implant removal and prosthetic joint replacement after embolisation of one branch of the left internal iliac artery were carried out with a good clinical and radiological evolution.
Conclusion: Intra-abdominal migration of a gamma nail lag screw is a rare but serious complication. The rate of intertrochanteric fractures continues to rise dramatically, in an increasingly elderly population, and the number of complications is expected to rise as a result. It is the surgeon's responsibility to be aware of, and to avoid the potential pitfalls which can lead to cut-out of the lag screw. Our poster clearly sets out the risks, how to avoid them and how to manage this type of complication. Our poster should be essential reading for anyone who carries out proximal femoral nailing. This will obviously be of interest to almost all orthopaedic and trauma surgeons.

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P5

Does mechanically measured bone strength within the proximal femur predict hip screw migration in vivo? Results from a multicenter trial

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Introduction: While the primary implant position is a known predictor of the stability of proximal femoral fractures, the role of trabecular bone strength within the femoral head to prevent hip screw migration is unknown. DensiProbe™ Hip is a mechanical probe for quantification of trabecular bone strength during the fixation of proximal fractures using a dynamic hip screw (DHS). The goal of this study was to assess if DensiProbe™ Hip measured bone strenght is an independent predictor of cranial DHS migration (DHSM) as signs of impending fixation failure.
Methods: 107 patients with 52 femoral neck and 54 pertrochanteric fragility fractures were included in this multicenter study. Intraoperatively, DensiProbe™ hip was inserted at the site of subsequent DHS tip and rotated around its longitudinal axis. Peak torque to breakaway the cancellous bone between the blades of the propeller like probe tip was registered. Postoperatively, patients underwent plain radiography to quantify the primary DHS position Areal bone mineral density (BMD) within the proximal femur was measured using DXA. Patients were followed –up radiographically at six weeks and three months after surgery to assess cranial DHSM in the ap plane.
Results: Univariate regression analysis showed small, but significant non linear correlation between DHSM and peak torque ($R^2 = 0.05$, $p = 0.044$). Stronger correlations were found between DHSM and the distance between the DHS and the central femoral neck axis (CNFA, $R^2 = 0.19$ $p = 0.00$), the lateral Parker ratio ($R^2 = 0.16$, $P = 0.00$) and the tip apex distance (TAD; $R^2 = 0.07$, $p = 0.006$). No significant correlation was found between DHSM and femoral neck areal BMD. Multivariate analysis revealed the distance from CFNA was the most important predictor of DHSM followed by the lateral Parker ratio and TAD. Peak torque was not an independent predictor of DHSM. There was a significant non linear correlation between lateral Parker ratio and peak torque ($R^2 = 0.16$, $p = 0.000$).
Conclusion: Screw position as measured by the distance from CFNA and the lateral Parker ratio and TAD, but not DensiProbe measured bone strength are independent predictors of DHSM. The lateral Parker ratio may indicate strength of the adjacent trabecular bone.

P6

Comparisons of preoperative three-dimensional planning and surgical reconstruction in primary cementless total HIP Arthoplasty: A prospective case series of 50

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Introduction: Classically, templating for total hip replacements (THR) is performed using a plain antero-posterior x-ray of the pelvis. However, measurements of important parameters such as true femoral offset and torsion or evaluation of intramedullary anatomy are inaccurate. Preoperative three-dimensional (3D) CT-based templating tools have recently become available. We evaluate intraopeative reproducibility of 3D-templating using HIPPLAN software (Symbios, Yverdon/Switzerland).
Methods: 50 consecutive patients undergoing primary cementless THR were included. All patients were operated by a single surgeon using a direct anterior approach. Pre-operative CT-based three-dimensional planning was performed using HIPPLAN software. Postoperatively, a second CT scan was performed in all patients. The difference between the planning and the real postoperative implant position was assessed by fusing the postoperative CT with the pre-operative planning-CT.
Results: The implant size prediction was correct in all cases for the stem size, in 47/50 cases (94%) for the cup size and 44/50 cases (88%) for the head length. The mean difference between the planned and the real (i.e. postoperative) leg length was 0.3 + 2.3 mm (min –5, max 6). The mean difference between the planned and the real femoral lateralization was 1.4 mm ±3.1 (min –5 max 7). The precision of the anteversion of the stem was 0.6° ± 3.3° (min –7 max 8). The mean differences in regards to cup inclination and anteversion were –0.4 ° ± 5 (min –9 max 10) and 6.9° ± 11.4 (min –14 max 33), respectively.
Conclusion: Three-dimensional planning of primary THR using HIPPLAN software allows accurate prediction of implant size. The planned three-dimensional stem position and cup inclination are intra-operatively reproducible with an excellent accuracy. The planned anteversion of the cup has not been well reproduced in this series.

P7

Increased Pelvic Incidence May Lead to Facet Joint Arthritis and Their Sagittal Orientation At The Lower Lumbar Spine

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Objectives: Correct sagittal alignment with a balanced pelvis and spine is crucial in the management of spinal disorders. The pelvic incidence (PI) describes the sagittal pelvic alignment and is position-independent. (1) However, it has barely been investigated on CT scans. (2) It may only change in adulthood if spinal deformities are present. (3) No gender difference is likely, but higher values have been reported for females. (4) It may either increase to compensate for a decrease in lumbar lordosis (LL) or be linearly associated with LL. (5) No studies have focused on the association between PI and facet joint (FJ) arthritis, orientation and tropism. Recently, increased pelvic lordosis has been linked to FJ arthritis at L5/S1. Therefore, our goal was to clarify the remaining issues about PI in regard to (1) physiologic values, (2) age, (3) gender, (4) LL and (5) FJ arthritis, orientation and tropism using CT scans.
Materials and Methods: We retrospectively analyzed CT scans of 620 individuals, with a mean age of 42.5 (range, 14–94) years, who presented to our traumatology department and underwent a whole body CT scan, between 2008 and 2010. The PI was measured by the angle between the hip axis to an orthogonal line the center of a line along the superior end plate of the first sacral vertebra. LL was evaluated on median sagittal slides by measuring the angle between the superior endplates of L1 and S1. FJs of the lumbar spine were evaluated for arthritis, orientation and tropism between the second lumbar and the first sacral level on axial planes.
Results: (1) 596 individuals yielded results for PI. (2) There was no significant difference for PI and age ($p = 0.07$), nor (3) gender ($p = 0.28$). (4) PI was significantly and linearly correlated with LL ($p = <0.0001$). The mean value for LL was 48.9°. (5) PI and FJ arthritis displayed a significant and linear correlation ($p = 0.0062$, OR 1.020 [95%-CI 1.005, 1.034]). An increased PI was significantly associated with sagitally oriented FJs at L5/S1 ($p = 0.01$). There was no significant difference for PI and FJ orientation at the upper lumbar spine nor PI and FJ tropism.
Conclusion: The mean value for PI on CT scans ranges around 50.8°. PI is neither significantly correlated with age nor gender. However, PI is significantly and linearly associated with LL, FJ arthritis and sagittal FJ orientation at the lower lumbar spine. Increased PI may lead to higher contact force on the lower lumbar FJs and cause FJ arthritis along with more sagittal FJ orientation. Individuals with increased PI and (and increased LL) may therefore be at high risk for FJ arthritis at the lower lumbar spine. Patients with increased PI (and increased LL) could benefit from corrective surgery and spondylodesis, once symptomatic or in the event of trauma.

P8

Trial Head Navigation and Leg Length Control in minimal-invasive Stem-first –Total Hip Arthroplasty: Operative Technique and Clinical Results

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Introduction: Dislocation and leg length inequality are among the most embarrassing factors for patient satisfaction after total hip arthroplasty (THA). In order to reduce the risk for dislocation due to prosthetic impingement and to prevent edge loading and probably to minimize squeaking it is important to maximize the intended range of movement (iROM), which is accomplished by positioning both components according to the combined safe-zone for correct combined version and combined inclination. Leg length equality is required not only for the patient's comfort but also for normal gait. This study shows how to control the combined orientation of both components intraoperatively using trial head navigation in minimal-invasive stem-first THA surgery.
Material and Methods: 779 minimal-invasive total hip arthroplasties have been performed from 2007 to 2012 in our institution using the minimal-invasive direct anterior approach (DAA). In 152 of these cases the trial head navigation was applied allowing accurate control of combined version and inclination intraoperatively according to the

specific combined safe-zone of the prosthesis system. All patients were positioned supine on an orthopedic table that is functioning as a leg positioner mainly. Leg length was measured within the surgical field using a caliper.
Results: Overall 94% of the patients received a ceramic-on-ceramic articulation. In the trial head navigation group an anatomic stem with stem first technique was used. No squeaking or any sign of impingement did occur in these patients and component orientation of cup and stem was in the combined safe-zone in 92% of these cases. In total we observed three dislocations during the six years period. Leg length did not differ more than +/– 5 mm.
Conclusion: Stem-first technique with trial head navigation does assist the surgeon intraoperatively in a straightforward way to ensure optimal orientation of total hip components in the combined safe-zone in minimal-invasive direct anterior approach for total hip arthroplasty. It yields excellent functional results and reduces the rate of dislocations substantially.

P9

Biologic reactions at ACL graft insertion sites measured by 99mTc-HDP-SPECT/CT tracer uptake

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Introduction: Not much is known about biologic reactions at ACL graft insertion sites. SPECT/CT is a hybrid imaging modality, which combines a 3D single photon emission computed tomography and a conventional computerized tomography. It allows accurate anatomical localization of metabolic tracer activity and allows therefore the correlation of surgical factors such as tunnel position and orientation with mechanical alignment, clinical outcome and biological factors. The purpose of this study is to investigate the correlation between SPECT/CT tracer uptake (intensity and distribution) and the stability and laxity of the knee joint and also the position and orientation of the tibial and femoral tunnels in patients after ACL reconstruction.
Methods: A consecutive series of patients (n = 66), which were complaining about pain and/or instability after ACL reconstruction were prospectively evaluated using clinical examination and 99mTc-HDP-SPECT/CT. Clinical laxity testing was performed including Lachman's test (0–2 mm, 3–5 mm, 6–10 mm, >10 mm), anterior drawer test (0–2 mm, 3–5 mm, 6–10 mm, >10 mm), pivot shift test (positive/negative) and patient-based subjective instability (yes/no). For analysis of SPECT/CT tracer uptake a previously validated SPECT/CT localization scheme consisting of 17 tibial, 9 femoral and 4 patellar regions on standardized axial, coronal, and sagittal slices, was used. The tracer activity on SPECT/CT was localized and recorded using a 3D volumetric and quantitative analysis software. Mean, standard deviation, minimum and maximum of grading for each area of the localization scheme were recorded. The position and orientation of the tibial and femoral tunnel was assessed using a previously published method on 3D-CT.
Results: Characteristics of instability, pivot shift as well as clinical laxity testing with 99mTc-HDP-SPECT/CT tracer uptake intensity and distribution showed no significant correlation. The tracer uptake correlated significantly with the position and orientation of the ACL graft. A more horizontal femoral graft position showed significant more increased tracer uptake within the superior and posterior femoral regions. A more posterior placed femoral insertion site showed significant more tracer uptake within the femoral and tibial tunnel regions. A more vertical or a less medial tibial tunnel orientation showed significant increased uptake within the tibial and femoral tunnel regions. A more anterior tibial tunnel position showed significant more tracer uptake in the femoral and tibial tunnel regions as well as the entire tibiofemoral joint.
Conclusions: SPECT/CT tracer uptake intensity and distribution showed a significant correlation with the femoral and tibial tunnel position and orientation in patients with symptomatic knees after ACL reconstruction. No correlation was found with stability or clinical laxity. SPECT/CT tracer uptake distribution has the potential to give us important information on joint homeostasis and remodeling after ACL reconstruction. It might help to improve our surgical ACL reconstruction technique by directing us to find the optimal tunnel position based on the results of biological activity with the achievement of joint homeostasis being our goal.

P10

Assessment of in vivo loading history of the patellofemoral joint- a study combining patellar position, tilt, alignment and bone SPECT/CT tracer uptake/distribu

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SPECT/CT could be used to evaluate the in vivo loading pattern of the patellofemoral joint before and after realignment surgery. The purpose of this study is to investigate, whether the patella position (height and tilt) influences the intensity values as well as the distribution pattern of SPECT/CT tracer uptake in the patellofemoral joint.
99mTc-HDP-SPECT/CT and conventional radiographs of consecutive 84 knees were prospectively obtained. Lateral radiographs were then analysed in terms of patellar height, the Insall-Salvati index and the modified Insall-Salvati index. Skyline views were analysed measuring the lateral patellofemoral angle according to Laurin. On long leg radiographs the mechanical leg alignment was classified as varus, valgus or neutral. 99mTc-HDP-SPECT/CT images were analysed for each anatomical region using a previously validated SPECT/CT localisation and grading algorithm. Mean, standard deviation, minimum and maximum of grading for each area of the localization scheme were recorded using a semiquantitative colour-coded grading scale (0–10). Nonparametric Spearman correlation coefficients were used to correlate the patella height, the lateral patellar angle and leg alignment measurements with the intensity of tracer uptake in each area of interest. Chi square statistics were used for categorical data. The level of statistical significance was $p < 0.05$.
16 (19%) knees showed valgus, 34 (40.5%) varus and 34 (40.5%) neutral mechanical alignment. A lower patella position correlated significantly with higher 99mTc-HDP SPECT/CT tracer uptake in all patellar and lateral femoral regions ($p < 0.001$). A higher lateral patellar angle correlated significantly with higher 99mTc-HDP tracer uptake in the superior lateral femoral parts and the tibial tubercle. The intensity of 99mTc-HDP SPECT/CT tracer uptake on the medial part of the patellofemoral joint significantly correlated with mechanical varus alignment of the knee ($p < 0.05$). The intensity of 99mTc-HDP tracer uptake on the lateral part of the patellofemoral joint significantly correlated with mechanical valgus alignment of the knee ($p < 0.05$). The intensity and distribution of the SPECT/CT significantly correlated with patella infera and patellar tilt angle, measured in conventional radiographs. Hence, SPECT/CT should be considered as imaging modality for evaluating patients with patellofemoral disorders and for follow-up of patients after patellofemoral realignment procedures.

P11

Surgical treatment of anteromedial rotatory instability with injury of anterior cruciate ligament and second degree lesion of medial collateral ligament

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Introduction: Anteromedial rotatory instability (AMRI) is a common Problem in athletes with injury of anterior cruciate ligament (ACL). Due to degree of lesion of medial collateral ligament (MCL) different therapy-strategies are described in the literature. Conservative treatment in combined ACL-injury and first degree MCL-injury, as well as reconstructive surgery in combined ACL-injury and third degree MCL-injury is well-established. However treatment regime of ACL rupture and second degree MCL-Lesion is discussed controversial in literature. Clinical results of conservative treatment are indifferent; a common surgical technique is not described.
In this study we want to suggest a surgical technique to treat this kind of knee joint injuries.
Methods: From 21 Patients with ACL-Injury we diagnosed 5 Patients with acute ACL rupture, second degree MCL-tear and anteromedial rotatory instability. All Patients were treated with the same surgical technique by the same surgeon. Postoperative treatments were standardized. We evaluated standardized knee examination according to international knee documentation committee (IKDC), anteromedial rotatory instability (AMRI), excessive medial knee opening (EMKO) and Lysholm score both preoperative and after 2, 6 and 16 weeks postoperative.
Results: All Patients showed good to excellent clinical results at the follow-up examinations.
The incidence of AMRI was significantly reduced to 0% (0 patients) compared with 100% (5 patients) preoperatively. An Evidence of EKMO was in none of the patients verifiable postoperative. Most patients had normal range of motion of the knee joint, whereas 1 patient (20%) lost 5° of range of motion in extension and 1 patient (20%) lost 15° in flexion. However in all 5 patients (100%) the findings

were graded as normal or nearly normal according to IKDC knee examination form. All patients showed improvement of Lysholm score in the follow-up examination 16 weeks postoperative.
Conclusion: We presented a new surgical technique for treatment of ACL-rupture and second degree MCL-lesion. This technique improved both, valgus and rotatory stability on short term outcome. In our opinion surgical treatment in this kind of injuries, and especially in athletes, is recommended.

P12

Gait and clinical outcomes in patients with severe knee osteoarthritis: a multivariate approach

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Introduction: Joint malalignment and gait deviations have been identified as important outcomes related to knee OA [1]. The relation between these outcomes and their evolution may be different between patients and challenging to interpret [2]. To understand the gait of patients with knee OA, a multivariate approach could be used. The aims of this study are to determine which gait parameters are best adapted to discriminate patients with knee OA, to discover if different gait profiles exist and to determine associations among gait outcomes and joint malalignment.
Patients/Materials and Methods: Ninety patients with knee OA and scheduled for a total knee arthroplasty (TKA) were included in this study. Twenty six elderly subjects were recruited as the control group. The hip-knee-ankle (HKA) angle, as an outcome of knee alignment, was assessed by full-limb radiography. The gait analysis was performed using a motion analysis system and force plates. Seventeen parameters were chose according to the literature in knee OA. The gait parameters were coded and normalized using fuzzy functions related to low, average and high modalities. The multiple correspondence analysis (MCA), a multivariate technique, was used to produce a simplified representation of the dataset information [3]. When relevant information was obtained from MCA, analysis of variances were performed to confirm differences.
Results: MCA highlighted a correspondence among 4 parameters: stride length, speed, knee flexion and hip flexion. MCA also highlighted a correspondence among 2 other parameters: thorax obliquity and knee adductor moment. Four knee OA gait profiles were highlighted: A, B, C and D. Comparing A with control group, excepted for the knee flexion range, there is no significant difference for all gait parameters. Comparing B with control group, excepted for the knee flexion range there is no significant difference for the spatial-temporal and sagittal parameters. However, B has significant more thorax obliquity and knee adductor moment than the control group. Compared to the control group, C presents significant reductions of the spatio-temporal and sagittal parameters. C has no significant thorax obliquity, but it has a significant less knee adductor moment compared to the control group. Compared to the control group, D has significant reductions of the spatio-temporal and sagittal parameters. D has a more important thorax obliquity, but no significant difference for the knee adductor moment compared to the control group. For the HKA angle, there is a significant difference between the A-C profiles (patients with normal to valgus alignments) and the B-D profiles (patients with varus alignments).
Discussion & Conclusions: We highlighted 6 gait parameters which most contribute to the variance of our MCA and their main correspondences. These relevant parameters could be considered for the discrimination of gait deviations in patients with knee OA. They could be used to simplify gait interpretation of this population. Despite patients have severe knee OA and will be submitted to TKA, 4 gait profiles were observed and associated with knee malalignment. Patients with varus profiles increase thorax obliquity and reduce forward displacement whereas valgus profiles may only reduce forward displacement to manage knee OA evolution.

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P13

Development and Validation of a Numerical Model for Total Ankle Replacement

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Introduction: Total ankle replacement (TAR) is an alternative to arthrodesis (AA) for surgical treatment of end-stage arthritis, with the main advantage to preserve a more physiological biomechanics of the ankle-foot complex. However, there are still major concerns regarding implants survival and complications at the bone-implant interface. Therefore, the design of revision implants will become crucial in the next years. The aim of this work was to develop and validate a numerical model of a tibia after TAR, for future analysis of ankle prosthesis design and surgical techniques.
Methods: The tibial component of the Salto prosthesis (Tornier, Inc., Edina, MN) was implanted into 7 cadaveric tibias, which were then fixed to a testing machine (Instron E3000). An axial compression test (2000 N) was performed at varying positions of the mobile polyethylene insert. Bone strain was measured in 5 regions of interest (ROI) using a 3D stereo-photogrammetric system. The 7 cadaveric experiments were replicated numerically. 3D models of the tibias were built from CT before implantation, while implant positioning was reproduced with second CT after implantation. Radio-opaque beads were attached to the tibias for CT registration. Nonhomogeneous bone elasticity was derived from CT. The numerical model was implemented and analyzed with FE software Abaqus.
Results: For the 7 tibias, the 5 ROI, and the 3 loading conditions, the coefficient correlation between measured and predicted strain was 0.70, with a slope of 0.71. The predicted bone strain was maximal around the keel, and at the border of the plate. Bone strain reached 2% below the keel and 5% at its anterior and posterior edge.
Conclusion: Total ankle replacement implants and surgical techniques are still open for improvement, especially for revision. We propose here a validated numerical model to address these questions. The numerical model predictions were in agreement with the experimental measurements. The predicted strains suggest that bone micro-damage and remodeling occur around the keel and at the border of the plate. This is confirmed by clinical X-Ray observations. As a first application, this numerical model will be used to evaluate prostheses prototypes and improve the fixation of primary and revision implants.

P14

A Numerical model to Evaluate two Designs of Tibial Anchorage for Total Ankle Replacement

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Introduction: There are concerns regarding mid- and long-term outcome of total ankle replacement (TAR). Survival rate of the implants is lower than that of other prosthetic joints and complications are more frequent, including formation of cysts and implant loosening. Furthermore, the design of revision implants will become crucial in the next years. Numerical models have the potential to help address these concerns. Our study aims to illustrate the potential of a numerical model by comparing the constraints at the bone-implant interface for two different designs of tibial components.
Methods: We used a numerical model developed and validated from 7 cadaveric prosthesis implantation combined with CT imaging. The validation of the model was achieved by comparison of experimental with numerical strain during axial loading. The numerical model calculated bone strain, tension-compressions and shear stress at the bone-implant interface, for an axial loading of 3000 N. Two distinct tibial anchorages were tested and compared: a central keel vs. a sagittal blade with a proximal cylinder.
Results: Bone strain was maximal above the fixation structure for both designs. Strain was below 1% for the blade design, while there was a small volume (4 mm^3) above 1% with the central keel. At the bone-implant interface, there was no tension, but only compression, for both designs. Peak compression was located above the plate for the keel design, and above the cylinder for the blade design. Shear stress was maximal above the fixation structure for both designs. Overall strain and stress were higher for the keel than for the blade design, because of a lower bone-implant contact area.
Conclusion: The sensitivity of our model was demonstrated by its ability to detect differences in the patterns of primary stability for two distinct TAR tibial anchorages. Our study doesn't allow qualitative assessment of one implant against the other because only a specific part of evaluation has been addressed. Nevertheless it offers a great potential to provide information regarding the primary stability of different implant designs and could also contribute to the development of revision implants.

P15

A new rare Complication of Osteonecrosis of the Distal Tibia after Dislocation Fracture to the Ankle Joint – Three Cases

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Introduction: Ankle fractures are very common among young and middle aged active persons. Dislocation of the talus combined with a fracture to the two malleoli and the associated ligaments is the most severe form. Immediate reduction helps to prevent further damage to the cartilage and soft tissue. Swelling, chronic pain, instability and consecutive osteoarthritis are the most common sequelae of possible

complications after such incidents. This report illustrates three cases of osteonecrosis in the unfractured tibial part which has not been described in literature before.
Methods: All three patients (27, 46 and 49 y.o.) were admitted to our hospital after suffering dislocation fracture to the ankle joint with immediate reduction. Two of them were operated immediately, one post-primarily. All of them were stabilized by medial and lateral screw and plate fixation, one required additional posterior buttress plating of the Volkmann's fragment. The course of the fracture healing was followed by X-rays, CT and MRI.
Results: The consolidation of the fracture was in two cases uneventful. One case showed loosening of the posterior buttress plate due to osteonecrosis in the unfractured distal part of tibia and a subsequent lack of purchase of the screws. Upon full weight bearing and sportive stress, a new entity of pain occurred 4 to 12 months after trauma. An MRI revealed for all three cases the diagnosis of osteonecrosis. None of the necrosis was detected in the distal fractured part in terms of a sequestrum but located in the distal not fractured tibial part.
Conclusions: Posttraumatic osteonecrosis is commonly associated with fractures of the femoral neck, talus and the scaphoid, due to their particular blood supply. Our cases suggest a new pattern of posttraumatic osteonecrosis. Whereas osteonecrosis of the distal tibia epiphysis is a known complication of the growing bone, there is to our knowledge no published data on osteonecrosis of the distal unfractured tibia associated with dislocation fractures of the ankle in adults. The consequence cannot be solely explained by disruption of a particular blood vessel; and non-traumatic causes of osteonecrosis (sickle cell disease, coagulopathy, steroid use and Morbus Gaucher) were not present. We assume that the combination of a heavy trauma, disruption of the periosteal blood supply and the surgical trauma added up to this new and rare but serious complication.

P16

Temporal Parameters Abnormalities Associated with Severe Hallux Valgus: A Gait Analysis Study

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Introduction: Hallux valgus (HV) is a condition, commonly seen in females, affecting the first metatarsophalangeal joint (MTP1) by progressive subluxation and valgus angulation. Studies have reported the altered biomechanics in HV but resources are limited. This study aims to assess the temporal parameters in patient with severe HV with more descriptive information regarding the stance duration.
Method: Two study groups were compared. The control group consisted of ten patients aged between 30–61(mean 45) years presenting no signs of HV. The case group consisted of ten severe HV patients aged between 35–58 (mean 49) years presenting a mean M1/M2 angle of 15.5° (13–20), M1/P1 angle of 31.3° (22–39) and DMAA of 9.7° (0–16) and markedly decreased functional scores including FAAM (Foot and Ankle Ability Measure) of 64.4% (23–94) and AOFAS for forefoot of 43 (25–52). The participants performed two walking trials of 50 m each wearing pressure insoles (PEDAR®) and inertial sensors (Physilog®). Temporal parameters were assessed for both groups. Comparison between the two groups was made using the nonparametric Wilcoxan rank sum test.
Results: When comparing the HV group with the control group, significant difference ($p < 0.05$) is observed in most temporal distance parameters (table 1).

Table 1: Temporal assessment results.

Temporal parameters	CASES	CONTROLS
Stance (%)	**59.4 (4.7)***	57.7 (2.4)
Swing (%)	**40.6 (4.7)***	42.4 (2.4)
Cadence	**103.3 (8.9)****	121.8 (12.2)
Load (S%)	11 (2.3)	12 (3.2)
Foot-Flat (S%)	**59.8 (9.7)****	54.0 (9.1)
Push (S%)	**27.8 (8.4)****	34.7 (8.2)
Stride length	**1.2 (0.1)***	**1.3 (0.2)**
HSP (°)	19.3 (3.1)	21.3 (7.1)
TOP (°)	**–69 (7.9)****	**–78.8 (6.8)**

* $p < 0.05$; ** $p < 0.01$; (%): % of gait cycle; (S%): % of stance phase;
(°): movement in degrees; HSP: heel-strike pitch angle; TOP: toe-off pitch angle.

Conclusion: Temporal parameters are visibly affected in the HV group. Longer stance phase including longer foot flat duration but shorter push off phase are characteristic patterns for the HV population. Clinical significance of this study includes potential benchmarking in characterizing the severity of HV, and potential contribution to objective evaluation of treatment efficacy and value of rehabilitation programs.

P17

Mineral density and penetration strength of the subchondral bone plate of the talar dome: high correlation and specific distribution patterns

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Introduction: The subchondral bone plate plays an important role in stabilizing the osteochondral joint unit and in the pathomechanism of osteochondral lesions and osteoarthritis. The objective of the study was to measure (I) mineral density distribution and (II) subchondral bone plate penetration strength of the talar dome joint facet in order to display and compare specific distribution patterns.
Methods: Ten cadaver specimen were used for CT-scans wherefrom densitograms were derived by means of CT-osteoabsorptiometry (CT-OAM), and for mechanical indentation testing wherefrom penetration strength was obtained.
Results: Two different distribution patterns were found for mineral density and penetration strength. 6 out of 10 specimens (60%) showed bicentric maxima (anteromedially and anterolaterally), while the other 4 specimens (40%) showed a monocentric maximum (either anteromedially or anterolaterally). Highly significant correlation ($p < 0.0001$) of both methods confirmed that mineral density relied on local load characteristics.
Conclusion: Biomechanical properties of the subchondral bone plate of the talar dome joint facet showed specific distribution patterns. CT-OAM has shown to be a reliable method to display mineral density distribution non-invasively. We recommend CT-OAM for non-invasive analysis of biomechanical properties of the subchondral bone plate in osteochondral joint reconstruction, as well as in prevention and treatment of osteoarthritis and osteochondral lesions.

P18

Stress fractures in the Swiss Orienteering and Triathlon National Teams – Analysis of Incidence, Localisation and Risk Factors

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Introducktion: Stress fractures in endurance sports are very frequent. Highly competitive athletes run the risk of suffering a stress fracture up to 8 to 25% per year. The influence and importance of several intrinsic and extrinsic risk factors (e.g. nutrition, orthopaedic, endocrinologic, and gynecologic disorders, or training methods) in professional athletes is largely unknown.
Methods: Retrospective analysis of data of all athletes having been member of the Swiss Orienteering or Triathlon National Teams concerning frequency, localisation and risk factors of stress fractures. In total, 200 athletes were inclueded (Orienteering, male, 89, female 67; Triathlon male 29, female 15). Data collection consisted of 1) analysis of medical recordings; 2) questionnaire; 3) personal interview.
Results: In total, 36 athletes suffered a stress fracture during their career (18%). Orienteering Women 22%, Orienteering Men 13%, Triathlon Women 13%, Triathlon Men 24%. 44% were located at the lower leg, 33% at the forefoot, and 11% at the middle and hindfoot and the pelvic/hip region each. 50% of all stress fractures occured between the age of 19 and 21years., 22% over 25 years, 19% 18 years and younger and 8% between the 22nd and 25th year. An increased ratio of primary and secondary amenorrhea were found in female athletes suffering a stress fracture. 38% of the female athletes suffering a stress fracture showed signs of osteopenia and osteoporosis. Orthopaedic-biomechanical risk factors were found in 1/3 of all athletes. A multivariate risk factor analysis showed significant single risk factors. In men, calcium substitution, and in women, very low body mass index, iron and vitamine substitution were identified.
Conclusion: Stress fractures are common in endurance sports, frequently accompanied by symptoms of the female athlete triade. Age and localisation showed typical patterns. The understanding and meaning of risk factors for stress fractures are important in order to identify athletes at risk. Potentially, this will help to prevent stress fractures by modifying life style (e.g. nutritional habits) and training (e.g. intensity, volume).

P19

Does proximal femoral osteotomy in Legg-Calvé-Perthes disease predispose to angular mal-alignment of the knee?

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Introduction: Through there is an impression that proximal femoral varus osteotomy (FVO) can result in a valgus deformity at the knee there is no agreements on this issue. This study was undertaken to ascertain whether a FVO predispose to the development of genu valgum in children with Legg-Calvé-Perthes disease (LCPD).
Methods: Ninety five children with unilateral LCPD who underwent a FVO during the active stage of the disease and 31 children who were treated non-operatively were followed till skeletal maturity. The FVO was performed with a 20 degree varus angulation in all the patients and weight-bearing was not permitted till the stage of reconstruction. The alignment of the knee was assessed clinically at skeletal maturity. A subset of 27 operated children also had full length standing radiographs of the limbs. The mechanical axis deviation (MAD), femur-tibial angle (FTA), lateral distal femoral angle(LDFA) and the medial proximal tibial angle (MPTA) were measured on these radiographs.
Results: The frequency of clinically appreciable mal-alignment of the knee was not greater on the affected side in patients who had undergone FVO when compared to the unaffected limb and also when compared to the affected limb in non-operated patients. The mechanical axis of the lower limb of operated children was relatively in more valgus than that of normal limbs but they fell within the normal range.
Discussion: This study does not support the impression that a proximal femoral osteotomy for LCPD predisposes to clinically relevant degrees of genu valgum in children who have had 20 degrees of varus angulation at the osteotomy site and who have avoided weight-bearing for a prolonged period following surgery. Further studies are needed to clarify if genu valgum would have developed if early post-operative weight-bearing was permitted.

P20

MRI changes in calf muscles of Cerebral Palsy (CP) patients after BoNT-A injections. Preliminary report.

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Aim: Mid and long term muscle modifications on MRI induced by Botulinum Toxin Type A (BoNT-A) injections. Schroeder et al. made a prospective study were two volunteers accepted to be injected with Botulinum Toxin Type A (BoNT-A) at the Gastrocnemius muscle. MRI and a biopsy was performed one year later showing an abnormal sign on MRI and denervation atrophy in the biopsy. MRI and Biopsy were correlated. The purpose of this study is to evaluate MRI changes on muscles of CP patients who underwent BoNT-A injections in the calf more than one year before.
Methods: Twelve CP patients (3 females, 9 males) underwent BoNT-A injections in the Gastrocnemius (GN) and Soleus (S) muscles. MRIs of injected and non injected leg were performed in all patients 30 months on average after the last injection (range, 12 to 60).
The reader was blinded for all clinical data and scored hyper intensity on T2-weighted sequences in the GN and in the S as present or absent, in comparison to the contra lateral side or to the non injected muscles of the same leg.
Results: Seventeen GN and 13 S muscles were injected. Mean age at first injection was 4.1 years (range, 2 to 7). Mean age at time of MRI was 8 years (range, 7 to 11). Patients were injected 3 times on average (range, 1 to 6). Time between injections was 12 months on average (range, 7 to 32).
Nine out of 17 GN and 11 out of 13 S had hyper intensity on T2-weighted sequences. Three out of 4 not injected S muscles showed MRI changes, probably because proximity of the injected Gastrocnemius. The anterior compartment of the involved leg always had normal MRI signal.
GN muscles with normal and abnormal MRI signal had similar BoNT-A dose. However, the time between MRI and last injection was shorter in patients with abnormal MRI signal (19 v/s 35 and 19 vs 41 months in GN and S). One patient had a GN biopsy showing histological denervation signs after 12 month post BoNT-A injection.
Conclusion: Denervation signs with high intensity signal on MRI T2-weighted sequences are still present over 1 year after BoNT-A injections. Further control group without BoNT-A injection should be done.
Significance: Indications for repeated injections at 3 or 6 months should be re-considered on the basis of this observation.

P21

Longitudinal evolution of lower limb ranges of motion in cerebral palsy

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Introduction: The literature is scarce regarding the long-term development of the clinical characteristics of patients with cerebral palsy (CP) (1, 2). Ranges of motion (ROM) of the lower extremities are important clinical parameters in CP patients, especially to interpret gait deviations (3). Also, knowing the longitudinal and long-term evolution of clinical parameters according natural evolution and treatment received can help the clinician to optimize treatment strategies CP patients.
Objective: The purpose of this study is to determine the long-term ROM of the lower extremities in CP patients with respect to the different types of treatment received.
Methodology: A retrospective research of clinical gait analysis database between 1993 and 2012 were performed according the following inclusion and exclusion criteria: have undertaken two complete clinical examinations, being between 5 and 15 years of age during the first examination, being older than 15 years in the second examination. ROM of the hip, knee and ankle measured with a manual goniometer during the clinical examination were analyzed. ROM of the legs that received treatment were compared with the ROM of the legs without treatment with a Mann-Whitney U test ($p < 0.05$).
Results: Twenty-four CP patients were included in this retrospective study. There were 12 hemiplegic patients, 10 spastic diplegia patients, and 2 tetraplegic patients corresponding to 40 legs with complete data. Fifteen legs benefited from surgical treatment and/or toxin injections (25 legs no treatment). Patients who had Achilles tendon lengthening improved their ankle dorsiflexion (an increase of about 6°, $p < 0.05$). Patients who had surgery on their hamstrings or an osteotomy showed an improvement or a stabilization of their hip flexion. However, the entire ROM for all the lower extremities joints decreased.
Conclusions: This preliminary study shows a general decline in long-term ROM of the lower limbs in CP patients. Decrease on the range of motion is reduced with surgical treatments. Future studies are needed to determine the relationship between the change of the clinical features and the walking ability in CP patients on a long-term period.

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P22

No need for search of asymptomatic urinary tract colonization before elective hip and knee arthroplasty

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HUG

Objectives: The search for asymptomatic bacterial urinary tract colonization and its eradication before elective hip and knee arthroplasty surgery is controversial, but reflects widespread practice. The influence of perioperative antibiotic prophylaxis on the evolution of urinary colonization is unknown.
Methods: Prospective observational study at Geneva University Hospitals with urine analyses before and 3 days after arthroplasty. Exclusion of patients with symptomatic infections or carriage of urinary catheters. Post-discharge surveillance by questionnaires to patients and general practitioners at 3 months after surgery.
Results: A total of 480 asymptomatic patients (370 hip arthroplasties; 297 females; median age 71 y; 61 immune-suppressed) were enrolled. On admission, 171 patients (35%) revealed one form of pathological urine analysis (169 leukocyturia, 26 positive nitrites, and 171 patients with a bacterial colonization mostly due to E. coli, and other classical pathogens). Almost all patients received a single-dose perioperative prophylaxis of cefuroxime 1.5 g IV. The median duration of postoperative urinary catheter carriage was 0 days (range, 0–13d). On Day 3 postoperative, urinary analysis was pathological for fewer patients (90 leukocyturia, 13 positive nitrites, and 198 colonizations). However, cefuroxime prophylaxis and/or natural fluctuation of colonization changed the microbiology of urinary colonization towards more Gram-positive pathogens. 50% of patients revealed another urinary microbiology within 4 days between admission and the postoperative period. Overall, only 30 patients (6%) developed a symptomatic urinary tract infection during a follow-up period of 3 months, of which one third of the pathogens were unrelated to those found during hospitalization for arthroplasty. All these symptomatic infections were treated with antibiotics. None of them (0%) seeded to the joint prosthesis. Minimal laboratory costs for preoperative urinary analyses alone were estimated at 33.000 CHF, respectively.

Conclusion: Provided that urinary catheters are avoided or removed as rapidly as possible, pre- or postoperative routine urine evaluation of asymptomatic arthroplasty patients are costly and only moderately predict the pathogen of a potential future infection. If symptomatic infection occurs in a small minority of these patients, a targeted individualized antibiotic therapy prevents for urosepsis and haematogenous spread to joint prostheses

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P23

The safety and efficacy of high-dose daptomycin combined with rifampicin for the treatment of osteoarticular infections

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HUG

Aims: Treatment of Gram-positive osteoarticular infections require an adequate surgical approach combined with long-term antimicrobial therapy.The aim of this study was to evaluate the safety and efficacy of high-dose regimens of daptomycin, which is a recently introduced antibiotic active against multi-resistant Gram-positive pathogens, administered to patients with osteoarticular infections in combination with rifampicin.
Methods: This single center, **non-comparative**, prospective study evaluated the safety and efficacy of **a combined regimen** of intravenous daptomycin (8 mg/kg/day) and oral rifampicin (600 mg/day) in patients with Gram-positive osteoarticular infections, with a minimal follow-up of 1 year. Creatine phosphokinase, transaminases, bilirubinemia, and serum creatinine, were measured at baseline and regular intervals.
Results: Sixteen patients (median age: 63.5 years; 11 males, 5 females) presenting withstaphylococcal (n = 15) or streptococcal (n = 1) osteoarticular infections were enrolled and treated with a median number of 2 (range: 1–6) surgical procedures. The median daily doses of daptomycin and rifampicin, administered for a median duration of 21 (range: 10–122) days,were 8.15 (range: 6.6–8.9) mg/kg/day and 600 (range 600–900) mg/day. The combined regimen of daptomycin and rifampicin was well tolerated by all except one patient, without requiring treatment adjustment or discontinuation. One patient developedallergic responses probably due to rifampicin after 42 days. Fifteen (94%)patients showed favorable clinical and microbiological outcomes.
Conclusions: The combined regimen of high-dose daptomycin and rifampicin was well tolerated and may provide a useful alternative to standard glycopeptide therapy for Gram-positive osteoarticular infections.

P24

Epidemiology of extended-spectrum beta-lactamase-producing Enterobacteriaceae in a septic orthopaedic ward

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Objective: Wards cohorting infected orthopaedic patients may be particularly prone to transmitting extended-spectrum beta-lactamase producing Enterobacteriaceae (ESBL-E), due to high antibiotic use and long hospital stays.
Methods: We analyze their epidemic pattern by performing molecular typing of ESBL-E isolated from patients and healthcare workers during 20 months from our septic ward.
Results: Between March 2009 and November 2011, 186 patients were admitted from the community and 1335 transferred from other institutions, totalling 12,401 patient-days with an average length of hospital stay of 27 days. Bed occupancy averaged 83%. Among 565 anal swabs, ESBL-E were detected in 204 samples from 45 patients, suggesting prolonged carriage in affected patients. In six patients two different ESBL-E strains were detected, and 3 patients carried three distinct isolates. Among the 45 positive patients, 29 (64%) were detected during the first three days of admission, the remainder after a median median of 13 days of hospitalisation, range 7–52 d). At the time of sampling, 26 patients received antibiotic therapy without clinical activity against their respective ESBL-E; a further 7 patients were treated with antibiotics which their ESBL-E strains were susceptible to in vitro (carbapenems or quinolones). Most positive patients were asymptomatically colonised with ESBL-E. Two patients had arthroplasty infections due to ESBL-E, of which one was acquired on our ward. We also screened 41 healthcare workers (HCW) on 49 occasions during the study period. Six samples (13%) were positive. None of the ESBL-E detected in HCW were related to any of the patient isolates. Among 60 environmental samples taken at the peak of the epidemic (room floors, beds, curtains, tables, doors, offices, computers, telephones, kitchen, physiotherapy material, and toilets), none revealed ESBL-E.
Conclusion: HCW may also be anal carriers, but their strains might be different from the patients. Second, among 25 cases with identical ESBL-E species and positive epidemiological links, only 9 were really attributable to our service. This underlines that epidemiological attribution of ESBL by simple vicinity, timing, and species identification might grossly overestimate transmission within a given unit.

P25

Consideration of the causative pathogen may be necessary for the decision for implant retention in the management of infected total knee prostheses

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HUG

Background: For prosthetic joint infections (PJI) of the knee, the option of debridement with implant retention harbors a higher risk of infection recurrence than procedures with implant removal.
Objectives: While staphylococcal methcillin-resistance is known as a risk for relapse; the inherent role of the underlying pathogen is practically always neglected in international recommendations. We hypothesize that retention of infected knee arthroplasties is futile for staphylococcal PJI but might be a valid option for streptococcal PJIs, which may show a better outcome with this approach.
Methods: Single-centre cohort study, Geneva University Hospitals 1996–2006.
Results: In 21 patients with a mean age of 80.4 years (19 immunosuppressed and polymorbid) a primary attempt was made to salvage the implant using open (11 cases) or arthroscopic (10 cases) lavage and debridement and 3 months of concomitant antibiotic treatment. After mean active follow-up of 7 years (range, 4–20 y), patients were in remission in only seven cases (7/21, 33%). The 14 recurrences occurred on average after 5.4 months after the antibiotic therapy (range, 0.5–17 mts) and were due to the same pathogen as during the first episode. However, this low success rate was different between the microbiological strata. Remission was achieved in 0% of all MRSA infections (0/3); in 0% (0/3) of methicillin-resistant coagulase-negative staphylococcal infections; in 29% (2/7) of methicillin-sensitive S. aureus infections; but in 75% (3/4) of infections due to various streptococci.
Conclusion: Our small case series in our arthroplasty cohort suggests that the decision for the option of debridement and retention of knee PJI should also base on the pathogen, and not merely on the methicillin-resistance. This approach is futile for MRSA infections, but might be a valid option for streptococcal PJIs.

P26

Isolated Musculoskeletal Echinococcosis, a Report of Two Cases

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Background: Alveolar echinococcosis (AE) is a highly lethal, invasive parasitic infection, caused by the larval form of the tapeworm E. multilocularis (EM). It is endemic in central Europe, especially in some regions of Switzerland. Humans are dead-end hosts. This disease is rather rare, but difficult to treat. The liver is affected in 98% of cases. Few cases with isolated infection of bone or muscle without liver involvement have been reported so far. We report two patients from rural area of Fribourg (Switzerland) with isolated musculoskeletal AE.
Case 1: 59 years old woman who presented with a recurrence of an inflammatory lesion in the thoracic paravertebral musculature after being treated initially in another hospital. She had received marginal surgical excision and antibiotics after identification of a coagulase negative Staphylococcus, which had been considered despite absence of an implant. Proof of EM came from the histopathological examination of the tissue removed at revision.
Case 2: 64 years old woman, presenting extensive chronic iliosacral osteoarthritis with progredient pelvis instability. Surgical debridement and stabilization was performed. Despite negative microbiological cultures she was treated with antibiotics for 3 months as histopathology showed a chronic osteomyelitis and granulomatous inflammatory reaction in the soft tissues. Histopathological samples taken at revision surgery performed one year later because of recurrence proved AE. Confirmation was obtained by PCR and serology. No other lesions could be identified in both patients.
Discussion: In both cases initial histology conclude to aspecific inflammatory granulomatous reaction. Diagnosis was confirmed more than one year after onset of symptoms. The two cases illustrate that musculoskeletal infection by EM exists even without affection of the commonest organs such as liver, lung or brain. The diagnosis of AE may be missed at histopathology and interpreted as bacteriological infection, possibly culture negative, delaying the diagnosis for an extended period of time. Negative serologic results do not exclude the disease.

Echinococcosis has to be part of differential diagnosis of tumorlike process especially in the presence of a culture-negative inflammatory process.

P27

Extra-articular knee resection for a secondary chondrosarcoma evolving from an isolated enchondroma of the distal femur: A case report.

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Introduction: Enchondromas are among the most current benign bone tumours. Malignant degeneration is extremely rare (<1%) and generally presents as a low grade chondrosarcoma. For localized grade 1 lesions, the treatment of choice is curettage. Wide excision and reconstruction is generally not necessary, unless locally advanced or more aggressive behaviour is suspected at presentation.
Case report: A healthy 72 yo male presented with pain and recurrent knee joint effusion. X-rays show a classical central distal metaphyseal enchondroma of the femur associated with subtle osteolysis of the lateral condyle. MRI confirms the presence of a locally aggressive chondromatous lesion based in a classical enchondroma. Core needle biopsy revealed a grade 1 chondrosarcoma, which was in contrast to the radiological aggressiveness of the lesion. Total body CT-scan did not reveal metastatic disease. A wide resection was planned, as a high-grade lesion and joint contamination was suspected.
We performed an extra-articular knee resection and reconstruction with a hinged modular total knee megaprosthesis. The definitive histology was grade 1 chondrosarcoma, the surgical margins were wide. The evolution was favourable and the patient was able to perform all his activities of daily living independently without pain at 6 weeks postop. Knee flexion reached 90°. The oncologic screening at 18 months did not show local or distant recurrence.
Conclusion: Joints near a benign tumour that suddenly become symptomatic or present an effusion might indicate a malignant transformation. Wide resection and prosthetic reconstruction remains an effective treatment option even in low grade cartilaginous lesions if (1) the adjacent joint is contaminated, or (2) joint-sparing surgery would result in a severe functional impairment of the limb.

P28

Dramatic malignant progression of a pigmented villonodular synovitis of the knee after 27 years of multimodality treatment

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Introduction: Pigmented villonodular synovitis (PVNS) is a rare benign tumour of the synovium, most commonly arising around the knee. Resection remains the treatment of choice. The diffuse variant of the disease is prone to local recurrence (30–50%). However distant dissemination is extremely rare. We report the case of a patient with massive loco-regional and late distant spread to the lungs of PVNS originating in the knee.
Case report: A 69 yo women presented to our service 27 years ago with PVNS in her knee. Despite multible surgical resections, synoviorthesis and external beam radiotherapy, no local control was achieved. The disease spread in all thigh compartments. Due to the resistance to all convetional treatment modalities, isolated limb perfusion with TNFα and Melphalan was performed, without any effect on local control. After the disease was diagnosed in iliac lymph nodes, the patient was subjected to a systemic chemotherapy protocol with imitamib, which had to be abandoned, due to intolerance. Due to a giant lymphoedema of the entire limb, making up for a considerable part of the patient's body weight and in view of significant skin invasion, a hip disarticulation was performed. Finally, rapidly growing lung metastases appeared on CT scan, confirmed by core-needle biopsy. Palliative chemotherapy was initiated.
Interestingly, histological analysis of the disease throughout the years remained consistent with classic benign PVNS. No sarcomatous dedifferentiation was observed, not even in the pulmonary lesions.
Conclusion: PVNS is a benign tumour, with a high risk of local recurrence. Malignant behaviour, with loco-regional and distant metastases remains extremely rare. A histologically benign appearance does not exclude a clinically malignant behaviour with systemic spread.

P29

Giant extraskeletal myxoid chondrosarcoma of the thigh treated by wide extraarticular resection and reconstruction with a tumor prosthesis

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Introduction: Extraskeletal myxoid chondrosarcoma (EMC) is a rare soft tissue tumour with a high risk for local recurrence and metastases. While this entity is resistant to radio- or chemo-therapy, wide resection remains the treatment of choice.
Case report: A 60 year old man presented to our service with a large mass in his right thigh, slowly evolving over the past 7 years. His main complaint was the volume of his thigh. Imaging showed a 23 × 13 × 14 cm tumour in the quadriceps, eroding the cortical bone and with potential contamination of the knee joint. The risk of a pathological fracture was estimated considerable. A CT-guided core-needle biopsy revealed a FNCLCC grade 2 EMC. A thoraco-abdominal CT scan showed multiple pulmonary metastases. Due to the palliative situation with a very slow disease progression, a wide extraarticular resection of the distal femur and reconstruction with a megaprosthesis were performed. Extensive skin necrosis necessitated three revision procedures for débridement and confection of a pediculated lateral gastrocnemius muscle flap. No complementary treatment was possible for the pulmonary metastases. At 18 months follow-up, he walked without crutches, was able to do his activities of daily living. He was painfree and highly satisfied with the result. During the follow-up, slow progression of the pulmonary metastases was noted, which remained asymptomatic.
Conclusion: Extraskeletal myxoid chondrosarcoma is a rare soft tissue tumour, and wide excision remains the treatment of choice. Whenever possible, limb salvage should be proposed to preserve function and quality of life.

P30

Wide resection of the lateral malleolus and adjacent tibial, talar and calcanear bones with ankle fusion and allograft reconstruction for an osteosarcoma

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Introduction: Primary bone sarcomas around the ankle are rare. Due to the proximity of neurovascular structures and limited soft tissue reserves, limb salvage is often not possible.
Case report: A 19 yo male presented with pain and a progressive swelling of his ankle. X-rays revealed cortical erosions and an extensive periosteal reaction (sunburst) of the distal fibula. MRI showed a large mass of the fibula invading adjacent soft tissue. The lesion appeared close to the ankle joint, but with the articular cartilage as a barrier and without joint effusion. Core-needle biopsy revealed a high-grade chondroblastic osteosarcoma. No metastases were detected. After presentation at our multidisciplinary sarcoma board, the patient was subjected to neo-adjuvant chemotherapy (AOST 03-331).

Without any sign of intra-articular contamination of the ankle joint, surgical treatment consisted of wide resection of the lateral malleolus including a large skin patch, the distal third of the fibula, the lateral surfaces of the tibia and talus as well as the insertion of the lateral ligament on the calcaneus. The distal parts of the anterior, peroneal, and posterior muscular compartments were resected en bloc with the tumor. The defect was reconstructed with tibio-talar and talo-calcanear fusion, bony allograft and a plate. Soft-tissue coverage was achieved with a free fascio-cutaneous flap from the controlateral thigh. Histological analysis revealed clear margins and 50% of tumor necrosis. The oncologic treatment was completed with adjuvant chemotherapy.
Conclusion: Wide resection and reconstruction of the lateral malleolus is technically demanding but possible in selected cases. Despite some important functional loss, limb salvage is superior to an amputation.

P31

Neoadjuvant therapy with denosumab in a giant cell tumour. A case report.

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Introduction: Giant cell tumour (GCT) is a benign but locally aggressive primary osteolytic bone tumour, prone to local recurrence after surgery. Denosumab is a human antibody against RANKL, an over-expressed ligand present on normal multinucleated cells, responsible for bone destruction in GCT. We report the case of a patient with an advanced GCT of the distal radius. The lesion was treated with adjuvant denosumab, followed by curettage.
Clinical case: A 28 years old patient presented with a classical honeycomb osteolytic lesion in the left distal radius. Core-needle biopsy confirmed the diagnosis of GCT. Due to the proximity to the radio-carpal joint and advanced scalloping of the metaphyseal cortical bone, joint-salvage surgery was not possible. We initiated a neo-adjuvant treatment with denosumab (XGEVA), 120 mg/ week for 1 month, followed by monthly injections for 6 months. During this time, a substantial bone recorticalization, without progression of the size of the tumour was noted. No local or systemic side effects were observed. We performed intra-lesional (curettage) excision and bone grafting after 6 months. Histological analysis revealed islets (10%) of viable tumour cells within fibrous tissue. Post-op evolution was eventless.
Discussion: While surgery remains the treatment of choice for GCT, joint-salvage may not always be possible in case of extensive epiphyseal involvement. The presence of osteoclast-like giant cells seems to make those lesions prone to the specific anti-RANKL treatment with denosumab. Denosumab appears to slow down tumour growth and promote recorticalization of eroded bone. It might allow less aggressive surgery in selected cases.

P32

Jaffé-Campanacci syndrome: an extremely rare cause of pathologic fracture of the femur

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Introduction: Non-ossifying fibromas are common benign bone tumors of children and young adults. They are usually single, asymptomatic and regress spontaneously in adulthood. Some rare cases of pathologic fractures have been described. Jaffé-Campanacci syndrome is the association of multiple non-ossifying fibromas, “café-au-lait” spots and some degree of type 1 neurofibromatosis. While the relationship between the two entities remains unclear, there seems to be some genetic similarities (partial or complete deletion of the gene NF1).
Case Report: A 17 yo female patient with a neurofibromatosis type 1 was referred to our tertiary centre with a pathologic fracture of the distal femur through a non-ossifying fibroma. She had a slight mental retardation and “café-au-lait” spots. Imaging revealed multiple typical non-ossifying fibromas of both distal femurs and proximal tibias. There was no impending fracture of the controlateral side, and no other findings on thoraco-abdominal CT scanner. The fracture was treated by minimal invasive plate osteosynthesis. Histological analysis of tissue samples taken during the intervention confirmed the histologic diagnosis of non-ossifying fibroma. The fracture healed eventless and the patient returned to work after 3 months. At 12 months follow-up, the patient remained pain-free. Imaging revealed remodelling of the lesions.
Conclusion: Jaffé-Campanacci syndrome is an extremely rare cause of pathologic femur fracture. These fractures can be treated like any other, and good outcome is expected. There is still no consensus in regards to definition of the disease and its relationship with type 1 neurofibromatosis.

P33

Arthrodesis of the Shoulder after Tumor Resection with an Autologous Double-Barrel Vascularized Fibular Bone Graft

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Introduction: Arthrodesis of the shoulder is a straightforward and established alternative to reconstruct the shoulder function after extensive tumor resection of the proximal humerus. Functional results after arthrodesis compare preferable with those after prosthesis or spacer reconstruction after proximal humerus resection. Patients satisfaction of nearly 80% can be expected and in contrast to prosthetic, or osteoarticularallograft reconstruction function does not deteriorate over time. However with complication rates of up to 43%, efforts to develop new surgical techniques, which might potentially lower this complication rates, are essential. The goal of the present report is to describe a new surgical technique of shoulder arthrodesis using a free double-barrel vascularized fibular autograft and analyse the first mid term experience using this technique after wide resection of malign tumors of the proximal humerus.
Surgical technique: Threw a longitudinal deltopectoral with excision of the previous biopsy track tumor resection is performed in a standardized fashion. If the tumor involves the glenohumeral joint without involvement of the scapular body, an extra-articular resection of the glenoid is performed. The rotator cuff muscles are dissected away from their scapular origins. The capsule is kept intact, and the glenoid is osteotomized medial to the capsular attachments, retaining as much of the glenoid neck as possible. The free fibula flap was harvested with proximal peronealpedicle, and the complete periosteal sleeve. The calculated length counted double the resection length of the proximal humerus. The fibular graft was then cut in two equally pieces with the periosteal sleeve remaining intact, providing blood supply of both parts. In order to restore a stable construct the double barreled fibular was V-shaped placed in situ, providing doubled buttress at the scapular, fixing the first limb to the glenoid and the coracoid process and the second to the decorticated undersurface of the acromion. For stable fixation of the construct a pre-contoured 4.5-pelvic reconstruction plate was fixed to be attached along the scapular spine, the acromion and the lateral aspect of the humerus bridging the scapular – autograft – humerus junction to improve stability and to protect the allograft. The arm was positioned in 15–30° abduction, 15°–30° forward flexion, and 30°–50° internal rotation. After fixation the peroneal pedicle was anastomosed end to side, or end-to-end to the to a local artery and vein respectively. At the end of surgery a latissimus dorsi rotational flap was performed to provide adequate soft tissue coverage and reduce risk of infection. All three selected patients had an intra- / extra-articular tumor resection around the shoulder with abductor muscle dysfunction or loss of axillary nerve function or both. A wide surgical margin was achieved in all patients. Despite adequate soft tissue coverage with a latissimus-dorsiflap, in one patient, in which the local tumor situation became systemic, a deep infection with repeated surgical procedures complicated the postoperative course. Unfortunately the little girl deceased 3 years after index surgery. However excellent results could be achieved in the remaining two patients, in whom tumor free survival and excellent shoulder function could be restored. Both could be reintegrated and are able to work, one as a trucker and the other in a sheltered workshop. For patients scheduled for tumor resection at the shoulder region a careful preoperative discussion regarding potential complications associated with the chosen procedure is mandatory. A better functional outcome needs to be balanced carefully against more extensive surgery, longer operation time, and a potentially higher complication rate.

P34

LCP 140° Paediatric Hip Plate for Fixation of Proximal Femoral Valgisation Osteotomy

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Introduction: Femoral osteotomy is one of the most widely performed reconstructive operation in paediatric orthopaedic surgery with applications in congenital and acquired disorders. Many implants have been used for the fixation of proximal femoral osteotomies, but so far, there is no literature about the use and outcome of the LCP 140° Paediatric Hip Plate for valgisation in children.
Methods: Between January 2011 and July 2012, 11 hips in 10 patients underwent valgisation of the proximal femur for different congenital and acquired disorders. Patients' demographics, perioperative details, postoperative outcome and complications were retrospectively collected and analysed.
Results: The mean age of the 10 ambulatory patients (one with bilateral operation) who underwent proximal femoral valgisation osteotomy was 9.6 years (range: 7.3 to 11.8 years). All having had an uneventful surgery their mean hospital stay was 5.2 days (range: 3–9 days). Callus formation was observed in all cases at 6 weeks postoperative control and consolidation was complete in all cases after a mean of 221 days (85–533 days). We did not see any delayed unions or any case of nonunion in our series. The mean corrected neck-shaft angle in our series was 20° (range 12° to 37°). The stability of the operative reduction including the corrected neck-shaft angle was maintained during the follow up period (mean: 459 days, range: 168 to 700 days). There were no recurrence (varisation) or complications requiring further treatment or revision.
Conclusion: In our series of 11 femoral valgisation osteotomies, the 140° LCP Paediatric Hip Plate was shown to be safe and applicable in the clinical setting with good results concerning the realization and maintaining of the corrected neck-shaft angle, duration of hospital stay, consolidation time and low complication rate. We therefore consider the 140° LCP Paediatric Hip Plate to be a valuable device for correction of pathological varus conditions of the proximal femur in children.

P35

Genetic instability of osteosarcoma cells during long-term in vitro culture

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Introduction: Osteosarcoma (OS) is the most frequent primary malignant tumor of bone in children and adolescents with a poor prognosis in case of metastasis formation. There are only a few established OS cell lines available for the research in the OS field. Here we have investigated by microarray analysis the gene expression of two OS cell lines, the human SAOS-2 and the mouse Dunn cells with low metastatic potential and derivatives thereof with high metastatic potential, the LM5 and LM8 cells, respectively, to address their genetic stability during long-term in vitro culture. The cell lines used represent the most common type of osteoblastic OS.
Methods: The SAOS-2/LM5 and Dunn/LM8 cell line systems were cultured in vitro for periods to achieve more than 150 and 460 cell doublings, respectively. The gene expression was analysed by microarray in early and late passages using Agilent SurePrint Human Gene Expression 8 × 60k and Agilent Mouse GE 4 ×44k v2 microarray kits, respectively. Chromosomal localization and pathway analysis was performed using DAVID (http://david.abcc.ncifcrf.gov/).
Results: In the low metastatic parental cell lines SAOS-2 and Dunn 53 and 79 genes, respectively, were differentially (>2-fold; fdr <0.01) expressed during in vitro culture. In the metastatic derivatives, the LM5 and LM8 cells, the number of differentially expressed genes increased to 429 and 437, respectively. The chromosomal localization of affected genes (>2-fold; p <0.05) revealed a significant clustering on certain chromosomes in all four cell lines, and even in defined cytobands in the human SAOS-2 and LM5 cells. In addition, pathway analysis showed a significant enrichment of genes involved in "focal adhesion".
Conclusions: All four cell lines investigated exhibited limited stability in gene expression during long-term in vitro culture, with a clear increase in the metastatic derivatives compared to parental cell lines. Chromosomal instability may contribute at least in the human OS cell lines, and this will be further investigated by comparative genomic hybridization. In addition, genes involved in focal adhesion, a process that may contribute to tumour progression, are heavily dys-regulated during long-term in vitro culture. Therefore, the interpretation of results obtained in vitro and in vivo from these often used osteoblastic OS cell lines systems should take in to account that some of the observed effects may be caused by the inherent genetic instability during long-term culture.

P36

Prediction of patient survial by MMP-1 and P16 immunoreactivity in osteosarcoma tumor samples taken before and after neoadjuvant chemotherapy

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Introduction: In osteosarcoma (OS) treatment, the most valuable marker with prognostic value for the chance of survival is the amount of tumor necrosis after neoadjuvant chemotherapy. However, by combining the extent of necrosis with other markers this chance may be predicted more accurately. We therefore performed immunohistochemistry of 36 known tumor marker proteins on OS tumor samples, collected before and after chemotherapeutic treatment. Changes in staining intensity and stained area were correlated with the patients' 5-year overall survival (5-YS).
Materials and Methods: Non-necrotic tumor samples at the time of diagnosis (biopsies) and after neoadjuvant chemotherapy (resections) were paraffin embedded to generate a tissue micro array (TMA) representing 86 patients. TMA sections were immunostained in duplicates for the expression of 36 tumor markers. A semi-quantitative 3-point scoring system, combining staining area and staining intensity (quantified with Matlab software) reflected the expression of the marker before and after chemotherapy. The average score of each marker was calculated. A marker was evaluated if more than 50% of the patients showed a change in expression. Assuming that a downregulation was associated with patient survival and an upregulation with patient mortality, we compared the marker expression before and after chemotherapy with the patients' 5-YS, resulting in a prognostic score. Between 32 and 39 patients met all evaluation criteria (i.e. non-metastatic OS, 5-YS data, neoadjuvant chemotherapy, biopsy, resection) for a given marker. Statistical analysis was performed using Fisher's exact test with $p < 0.05$.
Results: Nineteen out of 36 markers showed a change in expression in response to neoadjuvant chemotherapy in more than 50% of the specimens. Prominent changes in expression were, for example, seen with Vimentin (change observed in 87% of n = 38 evaluable samples), PTEN (84%, n = 38), Caprin (79%, n = 33), CXCR-4 (77%, n = 39), matrixmetalloproteinase (MMP)-1 (73%, n = 33) and tumor suppressor P16 (59%, n = 37). However, only expressional changes of MMP-1 ($p = 0.012$) and P16 ($p = 0.044$) yielded a significantly negative correlation with patient 5-YS.
Conclusions: A change in protein expression provides valuable information about the impact of chemotherapeutic treatment and thus, may further assist in predicting patient survival. Based on our results, we suggest monitoring MMP-1 and P16 immunoreactivity before and after neoadjuvant chemotherapy.

P37

Neuropilins: Potential Markers for Osteosarcoma progression?

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Introduction: Neuropilin-1 (NRP1) and Neuropilin-2 (NRP2) are multifunctional non-tyrosine kinase receptors for vascular endothelial growth factor (VEGF) and semaphorins. In several malignancies of epithelial origin, like bladder, breast, lung, gastrointestine and prostate cancer, a correlation between neuropilins and tumor progression was recently described. In contrast, little is known about the role of NRP1 and 2 in non-epithelial tumors like sarcomas. Therefore we investigated in the present study their expression in tissue specimens of osteosarcoma (OS), the most common primary bone tumor in children and young adults.
Methods: The expression of NRP1 and 2 was analyzed on a tissue micro array containing tumor samples of 66 OS patients using specific antibodies and was then correlated with overall, metastases- and progression-free survival as well as with the responsiveness of the patients to the neoadjuvant chemotherapy.
Results: While NRP1 expression did not show any significant correlation with the different survival parameters NRP2 expression significantly ($p < 0.05$) correlated with bad overall, metastases-free and progression-free survival. Furthermore, metastases-bearing patients positive for NRP2 in the primary tumor tissue had a significantly shorter survival than patients with metastases but without NRP2 expression. Also the responsiveness of the patients to neoadjuvant therapy showed at least in trend ($p = 0.19$) a negative correlation with NRP2 expression. Interestingly, the absence of NRP1 with concomitant expression of NRP2 was also a significantly bad prognostic factor.
Conclusion: This study points to a possibly important role of NRPs in OS. While the expression of NRP2 significantly correlates with a bad prognosis of the OS patients NRP1 expression alone is not a clear

marker. However, in combination with NRP2 expression the absence of NRP1 is an additional bad survival indicator, suggesting a somehow counteracting function of NRP1 towards NRP2. Our on-going experiments with OS cell lines with manipulated NRP1 and 2 expression will hopefully help to better understand the role and interaction of NRP1 and -2 in OS progression.

P38

Caprin-1 associates with Cyr61 within stress granules, induces resistance to cisplatin and promotes osteosarcoma intratibial growth and lung metastasis in mice

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Introduction: Osteosarcoma (OS) is the most common primary bone malignancy in children and adolescents. More than 30% of patients develop lung metastasis, which is the leading cause of mortality. Consequently, suitable early diagnostic markers of metastasizing OS and corresponding treatment targets are urgently needed.Recently, the extracellular matrix protein Cyr61 has been recognized as a malignancy promoting protein in OS mouse model with prognostic potential in human OS. In the present study, we aimed at the investigation of the role of Caprin-1, a novel Cyr61-interacting protein, in OS pathogenesis and metastasis formation.
Methods: We combined endogenous Cyr61 immunoprecipitation and mass spectrometric analysis to identify Caprin-1 as a new Cyr61-interacting protein. Then, we investigated the subcellular localization of Cyr61 and Caprin-1 using a detailed confocal microscopy analysis. Finally, we used an orthotopic OS mouse model to investigate the in vivo effects of Caprin-1 overexpression.
Results: Stable overexpression of Caprin-1 in human OS cells resulted in the formation of Caprin-1 and Cyr61 containing stress granules. Furthermore, we showed that Caprin-1 overexpression in OS cell lines enhanced their resistance to cisplatin. Importantly, SCID mice intratibially injected with OS SaOS-2 cells stably overexpressing Caprin-1 showed accelerated primary tumor growth and a remarkably increased lung metastatic load compared to mice injected with control SaOS-2 cells. Consequently, the survival of mice with Caprin-1 overexpressing tumors was significantly ($p < 0.0018$) shorter than that of mice injected with control SaOS-2 cells.
Conclusion: In conclusion, overexpression of Caprin-1, a novel Cyr61-interacting protein, in the human osteoblastic SaOS-2 OS cell line provoked co-accumulation with Cyr61 in stress granules, which are known to have apoptosis protective functions. This is consistent with the here reported more resistant phenotype of cells overexpressing Caprin-1 to cisplatin. Importantly, OS cells overexpressing Caprin-1 showed strikingly enhanced malignant phenotype compared to control cells in mouse experimental intratibial OS. From this and our previous studies,we conclude that both Caprin-1 and Cyr61, at elevated expression levels in human SaOS-2 cells, have related but distinct OS malignancy-enhancing properties.

P39

Photodynamic therapy as a novel strategy against osteosarcoma

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Introduction: In osteosarcoma (OS), standard treatment (EURAMOS protocol) increased the overall patient survival tremendously, but patients with metastatic or recurrent disease continue to have a poor prognosis. Thus, there is an urgent need for novel therapeutic approaches enabling an ever higher eradication of the tumor and an inhibition of metastatic spread.
Photodynamic Therapy (PDT) is a minimal invasive therapy that makes use of a so-called photosensitizer, a small molecule with laser light-induced cytotoxic activity on tumor cells. In this work, we propose an experimental setup for the application of PDT to treat OS. We will study different PDT settings, using novel carriers for the photosensitizer mTHPC (Foscan); such as its liposomal formulation Foslip, and a lipid-nanoparticle based mTHPC carrier (LNP). The treatment effect of all mTHPC formulations will be compared: We assume that LNPs will be the most efficient carrier for mTHPC, as we expect a higher tumor targeting, due to their favourable physical properties (size, PEGylation, payload).
Methods: SCID mice will be injected i.t. with human osteosarcoma cells. Tumor-bearing mice will then be injected i.v. with a single injection of the photosensitizer formulations (Foscan, Foslip and LNP encapsulated with fluorescent dye) for an initial biodistribution study. In a second study,tumor-bearing mice will be injected i.v. with different concentration of the mTHPC formulations. After 24h the tumor area will be irradiated with a laser light at different energy fluence (10 J/cm^2 and 40 J/cm^2). Intratibial primary tumor development and metastatic spread into the lungs will be monitored by micro CT, IVIS and FMT throughout the treatment.
Results: Preliminary results using Foslip showed a significant, time-dependent uptake of the photosensitizer in the primary tumor. Best treatment efficacy has been shown at a concentration of 0.05 mg/kg Foslip, showing less tumor-associated osteolysis.
Conclusion: We expect that we can improve current PDT practice using novel carriers for photosensitizers. In addition, we hope to develop an additional therapeutic modality to treat OS. As an ultimate goal, we hope to apply PDT intraoperatively, leading to higher tumor eradication than by surgery alone and minimizing the risk for recurrence and metastasis formation.

P40

CD44 acts as metastasis suppressor in an orthotopic xenograft osteosarcoma mouse model

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Introduction: Osteosarcoma (OS) is the most frequent primary malignant bone cancer in children and adolescents with a high propensity for lung metastasis. Therefore, it is of great importance to identify molecular markers leading to increased metastatic potential in order to devise more effective therapeutic strategies that suppress metastasis, the major cause of death in OS**.** CD44, the principal receptor for the extracellular matrix component hyaluronan (HA), is frequently found overexpressed in tumor cells and has been implicated in metastatic spread in various cancer types. Previously, we showed through stable shRNA-mediated silencing of CD44 in the highly metastatic human LacZ- transduced 143-B OS cell line that CD44 expression contributes to the metastatic activity of 143-B cells in vitro. Here, we investigated the effects of CD44 knockdown on in vivo metastatic properties 143-B cells.
Methods: Three groups of SCID mice were intratibially injected with 143-B/LacZ cells with stably down-regulated CD44 expression (143-B shCD44), control cells bearing non-targeting shRNA (143-B Ctrl shRNA), or control cells bearing the empty vector (143-B EV).Tumor development was examined weekly by X-ray and tumor volume was determined by caliper measurements. The mice were sacrificed 21 days after tumor cell injection and in situ lung perfusion was performed. Organs were fixed and LacZ gene expressing tumor cells were visualized upon X-Gal staining. The indigo-blue stained metastases on the lung surface were counted under the microscope.
Results: Mice bearing shCD44 xenografts developed larger primary tumors and had significantly increased number of pulmonary metastases when compared to those in control animals. In contrast to our in vitro data, experiments in vivo using the orthotopic xenograft mouse model implicated CD44 as a metastasis suppressor gene in 143-B cells.
Conclusions: The apparent discrepancy between in vitro and in vivo outcomes of CD44 knockdown on tumorigenic and metastatic properties of 143-B cells highlights the essential impact of tumor environment on OS progression. In conclusion, our study identified CD44 as a metastasis suppressor in this particular experimental OS model.

P41

Proof of principle study of metastasis suppression by P2G overexpression

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Introduction: The CXCR4/SDF-1 chemokine axis plays a role in growth and metastatic potential of osteosarcoma (OS) cells. In the present study we disrupted this axis using the $P2G_{SDF-1}$ mutant in 143B OS cells and evaluated the effect on tumour growth and lung metastases. P2G is an SDF-1 mutant which competes with the native SDF-1 for CXCR4 and thereby prevents the signaling.
Methods: lacZ tagged human 143B OS cells were manipulated to overexpress P2G or SDF-1. The cells carrying the empty vector (EV) were used as a control. The cells were intratibially injected in SCID mice. In order to characterize the tumorigenic properties of the cell lines X-ray and µCT scans as well as caliper measurement of the tumor volumes were performed.
Results: We found a significantly increased tumor volume for the P2G compared to the EV cells. For the tumor cells expressing SDF-1, a small, but not significant increase in tumor volume was observed. In vitro migration assays showed that P2G and SDF-1 overexpression diminished the SDF-1 mediated CXCR4-dependent migration of 143B

cells. We suggest that the P2G cells migrated less in vivo and thus contributed to primary tumor growth. In order to check this hypothesis, the number of lung metastases was quantified for the P2G and EV groups. Indeed, the number of micro-metastases was smaller in the P2G group when compared to the control. There was a clear tendency, albeit not significant, of fewer macro-metastases in P2G group compared to the control.
Conclusion: A previous study in the lab showed that the downregulation of CXCR4 by specifically blocking antibodies in SCID mice inhibited lung metastases of OS cells. In our study we found that overexpression of P2G in OS cells also efficiently diminished lung infiltration in mice. However, similar to the results derived in the antibody treatment study, macro-metastases were not affected. Apparently, there is heterogeneity in the cell population of 143B cells, which differ in their reliance on the CXCR4/SDF-1 chemokine axis in the metastatic process. Metastases counts correlate with changes seen in primary tumor size indicating that OS cells rely on other than SDF-1/CXCR4-mediated proliferation signaling pathway. The results obtained in the present study open the door to the more downstream analysis of the effect of CXCR4 downregulation by means of P2G expressed locally in the lung as a potential therapeutic strategy for metastasizing OS.

P42

ΔNp63α and GLI2 association in Osteosarcoma progression

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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. ΔNp63α and GLI2, a hedgehog signalling component, are transcription factors capable of inducing motility, invasion and metastasis in many types of cancer but their role in OS is poorly understood. We are investigating the influence of ΔNp63α and GLI2 in OS progression. We could show that expression of ΔNp63α and GLI2 is upregulated in invasive OS cell lines. In ΔNp63α overexpressed SaOS-2 cell lines (SaOS-2-ΔNp63α), GLI2 expression was evident when compared with the empty vector (SaOS-2-EV) where little or no expression could be detected. Treatment with GLI2 inhibitor (GANT61) in SaOS-2-ΔNp63α and 143B cells drastically reduced the expression of GLI2 when compared with SaOS-2-EV. Cell cycle analysis revealed that GANT61 treatment induced G0/G1 arrest in SaOS-2-ΔNp63α and 143B cells.
Methods: ΔNp63α stable SaOS-2 cell lines were generated by retroviral infection. The expression levels of ΔNp63α and GLI2 were analysed by western blot (WB) and real time PCR (qRT PCR) in OS cell lines. Co-localization analysis of ΔNp63α and GLI2 were performed by immunocytochemistry. FACS was utilised for determination of cell cycle stage after treatment with GANT61.
Results: ΔNp63α and GLI2 were upregulated in invasive OS cell lines as revealed by WB and qRT PCR. Immunocytochemistry revealed that ΔNp63α and GLI2 show colocalisation in the nucleus in SaOS-2-ΔNp63α and 143B cells. Treatment with GANT61 for 24 hours induced G0/G1 arrest in SaOS-2-ΔNp63α and 143B cells.
Conclusions: Our results indicate that there might be a mutual interaction between ΔNp63α and GLI2 in OS progression. To further elucidate the functional role, SaOS-2-ΔNp63α cells will be injected in an established intratibial mouse model and treatment with GANT61 will be carried out.

P43

Pain treatment with Meloxicam in a mouse Osteosarcoma tumor model results in reduced lung metastases formation

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Introduction: Osteosarcoma (OS) is the most frequent primary malignant tumor of bone typically affecting children and young adults. It is associated with a very poor prognosis particularly for those patients with metastasis at diagnosis. Recently we have established an in vivo tumor system for the orthotopic injection of the human 143-B/LacZ osteosarcoma cell line into the distal tibia of immunodeficient SCID mice. During the experiments the mice began to hobble, because of primary tumor caused pain. Because of this observation and the loose of bodyweight, the experiments had to be terminated early. The major aim of this study was to determine a procedure that avoid pain stress for the animals (refinement of the experimental procedure) and without influencing the outcome of the experiment.
Methods: 10E5 143-B/LacZ tumor cells were orthotopically injected into the tibia of SCID mice. The size of the leg (length and width) was measured using a caliper rule. Tumor growth and osteolysis in the bone were visualized by x-ray. Isolated lungs were stained in X-Gal solution and metastases were quantified. Pain treatment was started when the mice started to hobble. As analgesic substances either Meloxicam or Buprenorphin were injected intraperitonal 2X/day with a dosage of either 5 mg/kg or 0.1 mg/kg bodyweight per injection, respectively.
Results: An increased survival was observed for the mice with pain treatment. The mice of the control group treated with NaCl had to be sacrificed 26 days after tumor cell injection, whereas the group of animals with pain treatment survived additional eight days. In the second part of this study we investigated if the analgesic substances influence primary tumor growth and/or metastases formation. For primary tumor growth no differences were detected between the groups. In contrast, we found a significant reduction in the number of lung metastases for the group of animals treated with Melo-xicam in comparison to the control group or the animals treated with Buprenorphine.
Conclusions: Our results indicate that pain treatment with the NSAID drug Meloxicam significantly reduces lung metastases formation in our established 143-B/LacZ OS animal model.

P44

CR-EQUIPEMENTS™ SACH Foot versus Otto BOCK™ SACH Foot

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Introduction: The International Committee of the Red Cross (ICRC) has designed a Solid Ankle Cushion Heel (SACH) foot produced at low cost by CR-EQUIPEMENTS™. This foot is available worldwide in all orthopedic centers supported by the ICRC. The objective of this study is to compare patient satisfaction with the CR-EQUIPEMENTS™ SACH foot with that made by Otto BOCK™, the latter considered by many as the "golden foot."
Materials and methods: Cross over and double blind trial including patients with a traumatic trans-tibial amputation, autonomous in ambulation for more than two years and without co-morbidities affecting gait and balance. Each patient was equipped with one foot and then the other, without knowledge of the specific type. Each foot was worn for 7 days. A validated satisfaction questionnaire (SAT-PRO) [1] was completed at 3 stages, first at the time of inclusion into the study and then again after using each foot. In addition, we developed a 7-item questionnaire specifically addressing the prosthetic foot itself.
Results: There were 15 patients, 12 men and 3 women with a mean age of 46.9 ± 12.5 years (range, 26.9–73.4 years), who met the criteria of the study and completed the entire trial. The SAT-PRO questionnaire showed slightly better satisfaction for the CR-EQUIPEMENTS™ foot (80%; $p = 0.0025$) compared to the Otto BOCK™ foot (78%; $p = 0.019$); however this difference was not statistically significant ($p = 0.54$). The foot-oriented questionnaire revealed a difference in favor of the CR-EQUIPEMENTS™ foot, but this was not statistically significant ($p = 0.06$).
Discussion: This study demonstrated that the CR-EQUIPEMENTS™ foot provided comparable satisfaction to the Otto BOCK™.
Conclusion: This is the first study that addresses patient's satisfaction using the CR-EQUIPEMENTS™ foot. It is an important ethical issue in the context of humanitarian aid provided by the ICRC.
Reference: [1] Bilodeau S et al., Can J Occup Ther. 1999 Feb;66(1):23–32.

P45

Efficiency and cost analysis of patient-reported outcome assessment after total knee arthroplasty: Comparing paper questionnaires to tablets

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Introduction: Patient-reported outcome (PRO) assessment is an important outcome parameter after total knee arthroplasty (TKA). PRO tools like the Forgotten Joint Score (FJS) or the WOMAC score investigate patients' symptoms and impairments in daily living. The most common PRO assessment modality is paper and pencil questionnaires. The logistics and administration of paper questionnaires and manual data entry for statistical analyses are costly and time consuming. Tablets have become a favourable alternative to efficiently assess PRO measures.
Objective: To evaluate efficiency and costs of PRO assessment after TKA using two different modalities of administration: paper and pencil questionnares and tablet assessment.
Method: We prospectively followed-up patients (2 months and 1 year after TKA) administering different PRO scores in two modalities. The WOMAC score (24 questions) and the Forgotten Joint Score (FJS, 12 questions) were completed by 34 patients in their paper and pencil

version and by 50 patients on a tablet. 80 patients completed the FJS in its computer-adaptiveversion (FJS-CAT). Questionnaire completion was timed for all PRO assessment tools and modalities. Time for manual data entry of the pencil and paper version into our database was also recorded. The study nurse costs were calculated.
Results: Average time to complete the WOMAC score in a pencil and paper version and manual data entry was 598 seconds. Average completion time for the WOMAC score on tablets was 113 seconds with no further data entry being necessary. Average time to complete the FJS 12 was 107 seconds in its pencil and paper version (including manual data entry) and 33 seconds on tablets. Explanation time for the WOMAC and FJS 12 on paper was 21 seconds on average whereas the explanation time for the tablet versions of the WOMAC and the FJS12 was 97 seconds. Personnel costs for the WOMAC on tablet were substantially lower than for the pencil and paper version (2,91 sFr vs. 8,26 sFr). The personnel cost for the FJS-12 showed no significant difference (1,64 sFr) between the two modalities of administration.
Conclusion: PRO measurement with tablets is an efficient option of patient assessment. It can substantially decrease time and cost for data collection in large patient samples in clinical routine. This effect seems to increase with questionnaire length. Another benefit is the exclusion of potential transcription errors since no manual data entry is needed.

The numbers refer to the pages of this supplement.