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FM1

The influence of surgery on the long-term evolution of walking in cerebral palsy

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Introduction: Patients with cerebral palsy (CP) can receive different or combination of several treatments (including surgery, or a combination of both, for example physiotherapy, orthoses, botulinum toxin injection, muscle transfer, rhizotomy, or single event multilevel surgery [SEMLS]). These treatments aim to reduce the impact of motor impairments on CP function. Better understanding the effect of treatments on gait in CP patients is important to improve treatment strategies. Numerous studies have been performed at short-term but rarely at long-term with a longitudinal design. The aims of this study were: 1) to analyse long term evolution of gait using the Gait Deviation Index (GDI) and gait speed; 2) to observe the influence of treatments and possible confounding factors.
Methods: Forty-one CP patients (GMFCS 1 and 3), with at least two Clinical Gait Analysis (CGA) performed with a period of 5 years minimum between each CGA, were included (mean age: 10.2 ± 3.8 years at the first CGA, 20.0 ± 3.5 years at the last CGA). The GDI, gait speed and their evolutions (difference between the two CGA) were calculated. Patients were divided in three categories: no surgery, single level surgery and SEMLS. Statistical analysis was done to observe differences between the two CGA and considering the three categories. Pearson's correlations were conducted to evaluate the associations between GDI and gait speed evolution with confounding factors as age at surgery, body mass index, dimensionless gait speed, and their evolutions.
Results: GDI is higher at the last CGA (78.0 ± 11.3 vs. 84.0 ± 11.1, $p < 0.001$) regardless treatment categories. Significant improvement of GDI was found for the two categories of surgery (single level surgery and SEMLS). Normalized gait speed was statistically lower for all categories. Significant correlations were found: 1) between GDI and gait speed evolution 2) between GDI and gait speed at baseline and 3) between gait speed evolution and BMI evolution.
Conclusion: This study confirms the long-term benefice of orthopaedic surgery on ambulatory CP patients and more particularly for those with poor gait quality.

FM2

Validation of a software to measure the true three-dimensional length of the spine from radiographic images

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Summary: We developed the Spinal Measurement Software (SMS) to enable simple and accurate assessment of the true three dimensional shape and length of the spine using traditional X-rays and being part of the clinical procedure for patients suffering from scoliosis.
Hypothesis: The SMS can accurately assess the true 3D shape and length of the spine based on two orthogonal radiographs.
Design: Eight participants were enrolled to test the usability, repeatability and accuracy of the SMS.
Introduction: Knowledge about the 3D shape and length of the spine for patients suffering from scoliosis during growth is of high importance for pre-operative planning and for the assessment of the spine's growth under various surgical approaches. Currently, no tool is able to reliably measure the 3D shape and length of the spine within a clinical environment. Existing 3D imaging systems are not applicable clinically due to the high cost, time or exposure to radiations. Other methods like the commonly used T1S1 distance exist, but they rely on a single frontal radiographic image, which is a simplification and has major limitations for the true estimation of the length in 3D.
Methods: Each of the eight participants were asked i) to learn to use the SMS without any supervision and to answer a subjective questionnaire to quantify its usability, ii) to measure the length of five phantom spine based on CT-scan, iii) and based on two orthogonal radiographs. Inter and intra-observer variability were computed to assess the reproducibility of the software. The length measured with the CT-scan and the SMS were compared to assess the accuracy of the software.
Results: Results show a usability of 89%, a strong correlation between the SMS and the CT-scans (R-squared = 0.99) and a variability below 1% of the total phantom's length.
Conclusion: Overall, the SMS measure accurately the length of the spine, with a high repeatability and is user-friendly. This software can easily be used by the clinicians without significant change in the clinical procedure for AIS.

FM3

Early experience of surgical treatment with magnetically controlled growing rods in patients with early onset scoliosis

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Background: Untreated early onset scoliosis (EOS) can lead to severe cardiopulmonary impairment, or even death. Early instrumented spinal fusion results in decreased growth of the spine and thorax subsequently causing respiratory failure. Growth sparing surgical techniques have evolved over the last decades in EOS treatment, with distraction based system being preferred. Traditionally, these systems required repetitive 6-monthly operative lengthening procedures under general anesthesia. We would like to present our early experience with the use of magnetically controlled growing rods (MCGR) for the treatment of patients with severe early onset scoliosis.
Material and Methods: We report our preliminary experience of 21 patients, 6 boys and 15 girls, with severe EOS who are under current treatment with magnetically controlled growing rods (MCGR; MAGEC®).
Results: Between April 2014 and January 2017 we implanted 13 bilateral and 8 monolateral MCGR in 21 patients with EOS. We used pedicle screw for lower and pedicle hook – TP hook constructs for upper foundations and did not exert distraction forces at the time of implantation. 10 patients had either cast or brace treatment before MCGR implantation, 8 patients had prior surgical treatment with vertical expandable titanium rib prosthesis (VEPTR®), and 3 patients had no prior treatment. Average age at implantation of MCGR was 7 years (1–12). Average initial Cobb angle was 72° and average correction of Cobb angle after index surgery was 29° (15°–46°) or 40% of initial Cobb angle. In one patient a wound healing problem led to a slightly prolonged hospital stay after MCGR implantation. 2 patients required re-operation after conversion from VEPTR to MCGR implantation due to rib anchor dislocation. After a total of 67 outpatient lengthenings we had no implant related complications or malfunctions and no wound infection has occurred.
Conclusion: Our preliminary experience with the use of MCGR in patients with EOS shows promising results in regard of effectiveness and complication rate compared to traditional growth sparing techniques and other MAGEC series. "Soft upper landing" with hooks and avoidance of excessive correction forces might be the main reasons.

FM4

What is the real impact of flexible intramedullary nailing in pediatric forearm fractures?

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Introduction: Flexible Intramedullary Nailing (FIN) is considered as the treatment of choice for most displaced and unstable pediatric forearm fractures. When compared to closed reduction and casting (Orthopedic treatment OT), FIN decreases the risk for malalignement, requires a shorter immobilisation period and should theoretically decrease the number of clinical and radiological follow-ups. The purpose of this study was to assess displaced pediatric forearm fractures treated by FIN or OT in terms of number of clinical and radiological follow-ups.
Method: Retrospective study in two pediatric orthopedic university services (Lausanne & Geneva). Documentation of treatment modality, postoperative course and radiological follow-up for each case treated between 2010 and 2014 were reviewed. Among the data collected were the number of general anesthesia, the duration of immobilization, the rate of final malalignement, and the reported complications. Statistical and descriptive analysis of FIN and OT groups were performed.
Results: Out of 299 identified cases, 241 children aged 4 to 14 years were included. 168 were boys (70%). FIN was performed in 150 (62.2%) and OT in 91 (37.8%). The mean age was 9.9 years in the FIN group, and 7.4 years in the OT group. A similar number of radiographs and follow-up appointments was calculated in both groups (6 and 7, respectively). The mean duration of immobilisation was 19.2 days in the FIN group and 58 days in the OT group. There were 8 cases of >10° malalignement in the OT group, none in the FIN group. Complications were similar in both groups (14.7% FIN, 17.6% OT).
Conclusions: Children treated by FIN had significantly less malalignement but did not have less follow-up consultation or radiological evaluation, when compared to OT. Follow-up guidelines following FIN could decrease the need for radiographs without affecting the advantages of the technique.
Key words: fracture, forearm, children, ESIN, follow-up.

FM5

Tissue perfusion of the hand and forearm following reduction of a supracondylar fracture in the pediatric population

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Objective: Closed reduction and surgical stabilisation is generally considered the best treatment method for type II-IV supracondylar humeral fractures (SCHF) (Rigault and Lagrange classification). However, some surgeons still advocate a non-surgical treatment (the Blount method) which requires elbow immobilisation in elbow flexion. As most SCHF are associated with significant elbow swelling, flexion of the joint leads to increased pressure in the cubital fossa. This can compromise forearm perfusion and may promote neurovascular deficiencies. The aim of the present study was to evaluate forearm and hand perfusion under progressive elbow flexion in children treated with percutaneous pinning for SCHF.
Methods: 46 cases of SCHF type II–IV were treated by closed reduction and percutaneous. Fractures were classified 17 times as type II, 16 times as type III, 13 times as type IV. Mean patient age was 6.3 years. Time between trauma and surgery was 7.8 hours (mean) and mean surgical time was 30 minutes. At the end of surgery flexion crease diameters of both elbows were taken. Oxygen saturation and plethmograph wave were measured in extension and progressive elbow flexion. Flattening of the plethmograph wave and a decrease of oxygen saturation was recorded. Correlation of fracture type, swelling, plethmograph wave and saturation curve was evaluated.
Results: Flattening of the plethmograph wave was seen in 35 of the 46 patients with progressive elbow flexion. In 10 patients the wave pattern disappeared between 90 and 120° of elbow flexion and in further 19 cases the plethmograph wave was flat before maximal elbow flexion was achieved. Oxygen saturation levels decreased at the same time as the wave or at a slightly greater elbow flexion. Swelling documented by the increase in circumference was less in type II fractures than in type III and IV fractures. Only a weak correlation between fracture type, swelling and reduced saturation upon progressive elbow flexion could be found.
Conclusions: Elbow flexion of more than 90° can lead to reduced peripheral perfusion after closed reduction of a SCHF. While saturation values initially stay in the normal range, plethmograph wave pattern flattens immediately upon reduced arterial inflow. 22% of our patients presented with changes in wave pattern and reduced peripheral oxygen saturation during elbow flexion. We thus recommend a peripheral perfusion evaluation at the required degree of elbow flexion prior to immobilisation.

FM6

Early treatment of juvenile hallux valgus deformity – is the lateral hemiepiphyseodesis of the first metatarsal combined with a soft tissue release successful?

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Introduction: Juvenile hallux valgus (JHV) deformity is described as a varus deviation of the first metatarsal and valgus deviation of the first proximal phalanx, occurring in a child who is skeletally immature. Juvenile hallux deformity is rare in childhood and different therapeutic strategies are possible. An elegant method of correction is to influence growth by a permanent lateral hemiepiphyseodesis of the first metatarsal bone.
Methods: We retrospectively reviewed all patients operated from 2009–2014 with the diagnosis of a juvenile hallux valgus deformity at our institution. Included in our study were all patients with the operative technique of a permanent lateral hemiepiphyseodesis of the first metatarsal physis combined with/or without a soft tissue correction (modified McBride procedure). Postoperatively a soft bandage was applied redressing the first toe in a varus position for four weeks day and night, going on during night for another year. Patients with additional necessary operations and/or a main deformity of a hallux valgus interphalangeus were excluded. We evaluated radiographs at the initial visit and 1 year postoperatively. The intermetatarsal angle (IM), hallux valgus angle (HV) and the distal metatarsal articular angle (DMAA) were obtained in degrees (°).
Results: 75 feet could be included affecting 64 bilateral, 38 left and 37 right feet. Clinical follow-up was minimum 2 years. Median age at operation was 11 years 1 month (9 years to 13 years). Median IM was 12.6° ± 2.3 (8–19°), 1 year postoperative 10.99° ± 2.7 (6–18°) (p <0.001). Median HV angle was 24° ± 6.3 (11–41°), 1 year postoperative 16.9° ± 6.9 (5–36°) (p <0.001). Median length of MT I was 59.5 mm ± 5.1 (47.1–69.8 mm), 1 year postoperative 61.6 mm ± 4.9 (49–69) (p <0.001). Median DMAA was 11.1° ± 4.4 (6.4–23.1°), 1 year postoperative 6.2° ± 4.5 (3–25 degrees) (p <0.001). 3 feet had corrective osteotomies in later follow-up. No overcorrection or relevant deterioration of hallux valgus deformity occurred.
Conclusion: Permanent lateral hemiepiphyseodesis of the first metatarsal physis with soft tissue release is a very good technique correcting a juvenile hallux valgus deformity. The success rate is high provided that the child has enough foot growth left. Because of this fact, skeletal age should be 10–11 years in girls and 11-12 years in boys at time of operation. Postoperative wear of correcting bandage is an absolute necessity.

FM7

Clinical and radiological results of transphyseal ACL repair in children

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Introduction: Treatment of anterior cruciate ligament (ACL) injuries in children remains controversial. Historically surgeons preferred conservative treatment to prevent damage oft he growth plates in the growing child. Currently knee bracing until physeal closure and secondary ACL reconstruction or anatomical versus non-anatomically procedures are reported in the literature. In case of an unstable knee after ACL rupture in a child we prefer anatomical reconstruction of the ACL to prevent the knee from further damage e.g. menisceal tear or cartilage lesion. The aim of this study is to analyze the clinical and radiological outcome of children underwent transphyseal ACL reconstruction.
Methods: We retrospectively reviewed the data of patients with open growth plates treated for ACL rupture over the last 5 years at our institution. The cohort consisted of 88 patients (30 males and 58 females). Average follow up was 2.5 years. Tunnel size and fixation of the graft was documented. Concomitant injuries were recorded. Tegner and Lysholm scores were collected. Long leg x rays were performed initially and one year after surgery.
Results: After minimum follow up of 1 year the majority of patients showed excellent clinical scores. Knee stability was symmetric and all oft he patients returned to their former sports activity level. No significant growth disturbance occured
Conclusion: Transphyseal ACL reconstruction in children shows excellent clinical and radiological results at average follow up of 2.5 years. Considering the anatomy of the growing child by choosing the correct tunnel size and orientation no alteration of the growth plate has to be expected.

FM8

Treatment of unstable slipped capital femoral epiphysis with the modified Dunn procedure shows excellent clinical outcome and low rates of adverse events

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Introduction: Surgical treatment of slipped capital femoral epiphyses (SCFE) aims to restore the integrity of the femoral head neck junction in order to prevent loss of function and early osteoarthritis. In case of disrupted junction between epi-and metaphysis the risk for osteonecrosis is reported up to 60% in the literature. We evaluated the results of the modified Dunn procedure for the treatment of slipped capital femoral epiphysis with intraoperative documented disrupted junction between the epi-metaphysis, so called unstable slips, with regard to clinical outcome and adverse events such as avascular necrosis (AVN).
Material and Methods: We retrospectively reviewed 128 cases with SCFE after treatment for slipped capital femoral epiphysis between 1998–2016. Intraoperatively in 48/128 (37%) hips the connection between epi- and metaphysis was interrupted and the femoral head was moving on the femoral neck. Average slipping angle was 48°. Clinical and radiological results were gathered. Mean follow up was 4 years. Clinical classification system regarding stability of the femoral head was compared to the intraoperative findings.
Results: 45/48 (94%) hips had excellent clinical and radiological outcome. At follow up the Harris Hip and the Merle D'Aubigné score were 99,7 and 17, respectively. Slipping angle was improved significantly. AVN occured in three cases (6%). Clinical estimation of slip stability preoperatively was not corresponding to the intraoperative findings in the majority of cases.

Conclusion: With surgical dislocation and active preservation of the retinacular vessels, a controlled anatomic reduction of the mobile femoral head is possible. Excellent outcome can be found in the 94% of cases with low rates of adverse events compared to the current literature. Only by arthrotomy we are able to sufficiently judge the mechanical stability of the epi-metaphyseal junction of the proximal femur.

FM09

Sensitivity and specificity of the α-defensin test (Synovasure®)

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Introduction: Prosthetic joint infection (PJI) and septic arthritis of native joints are challenging to diagnose with current methods. Recently, a novel "immediate" test tracing the α-Defensin-Protein (Synovasure®, Zimmer) has been introduced into the market to improve diagnosis of infected joints. The aim of this prospective study is to evaluate the performance of this new test.
Methods: We performed 80 Synovasure® tests within 2 years, between February 2015 and January 2017. The patients included were either those with clinical suspicion of PJI or acute septic arthritis. We collected data from 49 hip prosthesis, 16 knee prosthesis, 7 knees, 3 ankles, 3 hips, and 2 shoulders.
Results: Infection was defined as positive microbiological findings. The α-Defensin test was positive in 33 cases. In 20 of these cases microbiology confirmed an infection, and in 13 no bacteria were found. The α-Defensin test was negative in 47 cases. In 4 of these cases bacteria were found in the microbiology test, and 43 cultures remained without bacterial growth. The sensitivity of the test was 83.3%, the specificity 76.8%, the positive predictive value 0.6, and the negative predictive value 0.9.
Conclusion: Synovasure is a quick and reliable adjunct to enhance the security in diagnosing PJI and septic arthritis. Together with other markers (C-reactive protein, sedimentation rate, pro-calcitonine) sensitivity and specificity are improved.

FM10

Influence of sonication on bacterial regrowth from antibiotic loaded PMMA scaffolds – an in-vitro study

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Periprosthetic joint infection (PJI) is a major complication after total joint replacement, The accurate detection of the causative bacteria is one of the most important steps during PJI treatment. Sonication has become a widely spread method in the diagnostics of PJI. Bone cement (PMMA) loaded with antibiotics is an established option for fixation of artificial joints. There is some evidence that remaining antibiotics can be released during sonication leading to false negative sonication results. Aim of this study is to analyze the effect of sonication on antibiotic release and bacterial regrowth of bacterial biofilms attached to standardized antibiotic loaded PMMA scaffolds. Clinical isolates from S. aureus (MRSA), E. faecalis, S. sanguis and P. acnes were obtained from clinical samples causing PJI. PMMA cement loaded with Gentamycin and Vancomicin or Gentamycin and Clindamycin, namely Copal G+V and Copal G+C (Heraeus, Austria) wasused as clinically available and moulded in Dynstat™ scaffolds. Antibiotics were removed from the scaffolds with a 10-days respectively 17-days washing (P. acnes). Biofilm was grown on the scaffolds in TSB. After 24 h, the test scaffolds were sonicated according to an established clinical routine (Trampuz 2007). Sonication fluid was plated at 0h, 1h, 2h, 4h and 8h and bacterial counts were enumerated as >500 CFU/mL, between 100–500 CFU/mL, between 50–100 CFU/mL and <50 CFU/mL.
Results: Bacterial counts in the sonication fluid were highest (>500 CFU/mL) with MRSA followed by E. faecalis and S. sanguis (between 100 and 500 CFU/mL) and remained unchanged for all time points for both types on PMMA. Negative controls showed no viable bacteria in the sonication fluid, while positive controls showed the same amount of bacteria in the sonication fluid as the test scaffolds. For P. acnes 8 out of 10 scaffolds showed bacterial growth <50 CFU/mL while negative control showed >500 CFU/mL after 0h and 1h what declined to between 100 and 500 CFU/mL for the next three timepoints.
Conclusion: Sonication did not influence bacterial regrowth in 3 out of 4 strains. Anyhow results for P. acnes are of concern as the results from sonication fluid would have been rated negative for PJI while negative controls would have been rated positive for PJI in clinical routine.

FM11

Early targeted antiobiotic therapy with programmed antibiotic window in a 2-stage-exchange method for prosthetic hip-infection is associated with excellent infectiological outcome after two years

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Background: Prosthetic joint infections are a rare but major complication with impact on patient mortality, morbidity and health costs. The optimal treatment algorithm with combined surgical and infectiological treatment is still debated especially the moment of re-implantation, the use of specific antibiotics with the spacer in place and the duration of antibiotic treatment. We present data from an orthopedic hip-arthroplasty cohort with a 2-step-exchange early targeted antibiotic treatment strategy with a programmed antibiotic window before re-implantation.
Design: Retrospective cohort analysis and systematic review.
Methods: From 2003 through to 2014 35 standardized 2-step-exchange hip-arthroplasties for prosthetic joint infection were performed. In all cases possible, preoperative arthrocentesis was done for identification of the causing microorganism. The infected implants were removed using a trochanteric flip approach allowing a thorough debridement and preventing additional harm to the musculature. The cement spacer was individually formed according to the anatomic situation. In some cases a double spacer was necessary. The empirical antibiotic therapy was switched to a targeted as soon as the causative organism was identified. A planned second look surgery was performed 3–4 days after the first surgery to remove hematoma. After six to eight weeks, targeted antibiotic therapy was stopped with the spacer in-situ. An antibiotic window of at least one month was maintained before the definitive prosthesis was implanted. Antibiotic therapy was given 4–6 weeks postoperatively. Patients were prospectively followed at least for two years after implantation of the new hip. The infectiological outcome was monitored, as well as the functional outcome, using a modified Harris hip score.
Results: All 35 patients were infection free after a follow-up of more than 2 years. Functional outcome depended highly on the soft-tissue and bony situation before the 2-stage-exchange.
Conclusion: Early targeted standardized therapy with a programmed antibiotic window before re-implantation of a prosthesis is associated with an excellent and probably superior outcome if compared to other algorithms published in the literature. Standardized surgical procedures including a tumor-like debridement and restoration of the patient's normal microbiome before final implantation might play a crucial rule in this process.

FM12

Periprosthetic joint infections with Propionibacterium acnes: outcome after surgical and antibiotic treatment

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Introduction: Periprosthetic joint infections (PJI) are one of the major complications after total joint replacements. Propionibacterium acnes (P. acnes) is a low virulent skin commensal which is known to cause invasive infections such as PJI. Treatment of PJI mostly consists of debridement with or without exchange of the implant together with postoperative longtime antibiotic treatment. The primary aim of this study was to evaluate the relapse rate after surgical and antibiotic treatment of PJI due to P. acnes.
Methods: Retrospectively we analyzed patients with at least one positive specimen for P. acnes in joint aspiration, intraoperative tissue or sonication fluid in presence of a total joint replacement, between 2005 and 2014. One positive sample was classified as contamination and two or more as infection. Patients without a follow up of 2 years were excluded. Surgical technique, type of antibiotics and outcome was analyzed. In case of two-staged exchange duration until reimplantation was noted. Cases who received no antibiotics postoperatively despite having a PJI were excluded from outcome analysis. Relapse was considered with ≥2 samples positive for P. acnes during follow-up
Results: In the given timeframe we identified 28 patients with P. acnes PJI (19 shoulders, 9 hips) and 24 contaminations (9 shoulders, 8 hips, 7 knees). Mean time of primary implantation until infection was 79 months. 4 Patients received no antibiotic treatment and were excluded from outcome analysis. Preoperatively in 6 cases (all shoulders) arthrocentesis was positive for P. acnes but only in 5 PJI was confirmed, resulting in a positive predictive value (PPV) of 83%.

16 shoulder prostheses were infected on average 52 months after implantation. 9 implants were exchanged two-staged, 4 one-staged and 3 were debrided with implant retention without any relapse. Mean time to reimplantation was 6.6 months. In 8 hips mean time from implantation to infection was 104 months. 5 implants were exchanged two-staged, two one-staged and one debrided. Medial time to reimplantation was 4 months. Two patients (8%) had a relapse, of which one had a debridement only and the other a two-staged approach with reimplantation after 3 months. Relapse occurred after 3 months and 6 years respectively.
Conclusion: P. acnes was only found as a contaminant in knee replacements. Arthrocentesis showed a PPV of 83%. Despite surgical and antibiotic treatment of PJI due to P. acnes there is a relapse rate of 8%.

FM13

Gentamicin loading of calcium phosphate-coated implants prevents experimental Staphylococcus aureus device associated infection in vivo

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Calcium phosphate (CaPh) coating of orthopedic implants such as hip and knee prostheses has been shown to improve osseointegration. Despite advances in implant integration, device associated infection (DAI) is a complication associated with all orthopedic devices. Current strategies to prevent DAI include systemically applied antibiotics and/or local antibiotic delivery systems such as antibiotic-loaded bone cement. The aim of this study was to determine if gentamicin may be loaded into a CaPh coating and to test the efficacy of this strategy for preventing DAI in vivo. The optimal loading conditions of gentamicin on to CaPh-coated TAN disks and screws was determined after in vitro incubation for a range of time points (range: 1 sec to 60 min). The release kinetics of gentamicin from the loaded implants was measured by spectrophotometry after derivatization with o-phthaldialdehyde. Antibacterial efficacy of the released gentamicin was then assessed in vitro using methicillin-sensitive Staphylococcus aureus NCTC 12973 (MSSA) and the EUCAST Disk Diffusion Method for Antimicrobial Susceptibility Testing. Finally, we implanted gentamicin sulfate-loaded CaPh-coated screws, or screws lacking gentamicin, into the left tibiae of adult female Wistar rats following inoculation with a clinical strain of S. aureus (1x10E6 CFU; n = 9 per group), to determine the efficacy of this strategy for preventing DAI. The CaPh coating was rapidly loaded with gentamicin following immersion, with maximal loading observed at <1 min incubation. Increased incubation times did not enhance gentamicin loading into the CaPh coating. The rapid uptake of gentamicin into the CaPh coating was also accompanied by a rapid release profile for gentamicin from the material, with >95% gentamicin released within 15 mins as determined spectrophotometrically, and by assessing antibacterial efficacy in zone of inhibition assays. This antibacterial efficacy was also confirmed in vivo, with a gentamicin-loaded CaPh-coated TAN screw able to completely prevent S. aureus infection in 7/8 inoculated animals (one excluded due to contamination with another bacterial species), whereas all animals not receiving gentamicin remained infected. In conclusion, gentamicin loading of CaPh coated implants is a promising approach for preventing S. aureus DAI in vivo. However, further studies are required to investigate the efficacy of this strategy in the clinical setting.

FM14

Perioperative contamination of knitted cotton outer gloves in hip and knee arthroplasty surgery

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Introduction: Knitted cotton outer gloves offer protection against surgical glove perforation and provide improved grip on instruments needing forceful manipulation. These gloves absorb blood and other fluids during surgery, and may therefore also gather contaminating bacteria. To date, there is no published data on microbiological contamination of these gloves during surgery. Therefore, despite overall satisfaction in clinical use, these gloves may still represent a risk of infection, particularly in implant surgery.
Methods: Knitted cotton outer gloves used in primary and revision hip and knee arthroplasty from two Swiss hospitals were collected and stored at –80 °C until batch analysis. After thawing, the conservation fluid and gloves were sonicated and vortexed, followed by membrane filtration. Membranes were cultured on enriched blood agar under aerobic and anaerobic conditions for 21 days. Colony forming units (CFU) were counted to determine total microbial load for each pair of gloves. Microbial growth was identified by MALDI-TOF.
Results: Forty-three continuously sampled pairs of knitted outer gloves were analysed, 24 from primary hip arthroplasty, 10 from primary knee arthroplasty, and 9 from revision arthroplasty. Hospital A provided 29 samples and Hospital B 14. Under aerobic culture conditions, 27 (63%) samples remained sterile, and CFU counts ranged 0-1103, with 6 (14%) samples yielding >100 CFU. Under anaerobic culture conditions, 25 (58%) samples remained sterile, and CFU counts ranged 0-3579, with 9 (21%) samples yielding >100 CFU. There was a significant difference between both hospitals regarding contamination ($p < 0.0001$ for aerobic and $p = 0.007$ for anaerobic cultures). The other covariates were not significantly associated with the results. Strain identification revealed only skin commensals, the vast majority being coagulase negative staphylococci and Proprionibacterium acnes.
Conclusion: This is the first study examining peroperative contamination of knitted cotton outer gloves. The distribution of results indicates sound methods. No or very low microbial contamination could be identified on the majority of the gloves. However, a relevant proportion of the samples showed contamination far higher than estimated minimal thresholds for implant-associated infection. While significant differences could be observed between both hospitals, this study could not identify further risk factors.

FM15

Therapy of chronic recurrent osteomyelitis with multi-resistent pseudomonas aeruginosa using local antibiotic release by a custom made tibia nail

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Introduction: The management of osteomyelitis can be challenging especially with recurrent infection which not only require rigorous intramedullar sanitation but also intravenous antibiotic treatment followed by several weeks of oral antibiotic medication. Injured bone is prone to osteomyelitis since microvascularisation is disturbed and required antibiotic concentration for bacteriostatic or bacteriolytic effects might therefore not be achieved. Treatment of a patient with recurrent osteomyelitis after a 3rd grade open tibia fracture at our hospital failed several times due to recurrent infection with Pseudomonas aeruginosa even after adequate antibiotic treatment. However, Pseudomonas aeruginosa became multiresistent and suitable antibiotic treatment was limited to Colistin. The objective of this case report was to establish an intramedullary rod construct with PMMA to locally administer Colistin.
Methods: First, elution of Colistin was tested with ascending concentration by mixing with Copal G+C plus. Furthermore, mechanic stability of Colistin and Copal mixture was tested by ISO 5833. An appropriate amount of Colistin was mixed with Copal G+C plus and added to an Ender nail which was placed in a silicon sleeve. The silicon sleeve was removed after 5 minutes when bone cement was cured. The nail-cement construct was temporarily implanted into the tibia after intramedullar reaming and rigorous lavage. Patient received additional i.v. antibiotics for 12 weeks and was monitored in an outpatient clinic setting.
Results: Colistin was eluted from Copal G+C plus over a period of 2 weeks whereas mechanic stability was also reached based on ISO 5833. The patient recovered on time and lab test showed that leucocytes and CRP declined in a continuous fashion and received normal levels after 3 weeks. The tibia nail was explanted after 2 weeks and radiographs showed sufficient bone regeneration. The patient is pain free since 2 years without any signs of infection and controls always showed normal blood tests.
Conclusion: We provide evidence that Colistin can be locally applied with PMMA matrix providing appropriate concentration due to elution over a period of at least 2 weeks. This technique demonstrates a custom-made solution for patient with multi-resistent osteomyelitis for Pseudomonas aeruginosa when conventional treatment fails.

*FM16

Morbidity and mortality after unplanned excision of soft tissue sarcomas

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Introduction: Soft tissue sarcomas (STS) are rare tumours (1–2% of all cancers). Wide surgical excision is the cornerstone for curative treatment. Literature suggests that management in specialized centres displays better local control, functional outcome and survival, to a lower prize. Up to 50% of STS are referred to sarcoma centres after unplanned excision. We reviewed our data to compare 1° "adequate" excision in our hands with 2° treatment after initial unplanned excision (tumour bed excision TBE).
Materiel and method: Sixty-four (29%) of the 221 patients treated for STS in our sarcoma centre between 2000 and 2014 were referred after unplanned excision. We built two groups of patients with comparable tumour size (<10 cm), depth, grade and stage, treated either primarily or by TBE in our centre to compare local and distant recurrence rates and functional outcome of two similar cohorts. From the 221 patients treated in our centre, 45 were excluded because they were deceased, 11 were lost to follow-up and 56 because their tumour was >10 cm or located on the foot or hand area. From the remaining 109 patients, 59 accepted to be part of the study: 27 with unplanned excision were placed in the TBE group (TBEG), whereas the remaining 32 were in the control group (CG). Men/women ratio was 18/9 in the TBEG and 17/15 in the CG. Mean age was 54yo in the TBEG and 50yo in the CG. All included patients completed the MSTS and the TESS scores after at least 10 months after their last surgery.
Results: Mean follow-up was 6.5 years in both group. Average size of the tumour was 40 mm in the TBEG and 57 mm in the CG. Tumour residue was found in 16 (59%) patients in the TBEG. There was 1 local recurrence (3.7%) in the TBEG and none in the CG. Four patients (14.8%) had distant recurrence in the TBEG and 3 (9.4%) in the CG. There was no statistical difference in the subjective functional outcome (MSTS score was 25.5 in the TBEG versus 24.4 in the CG and TESS score was 88.4 versus 92.9 in the CG) TG underwent 3.4 surgical interventions and stayed 17 days in hospital, as compared to 1.4 interventions and 12.4 days in the CG.
Discussion: Our study compares two similar selected groups of patients with similar tumours (size, depth, grade and stage). Mortality and morbidity after unplanned excision of STS was not significantly higher as compared to primary excision in our centre. However, unplanned excision led to more surgical procedures and longer hospital stay, resulting in higher cost.

FM17

MRI grading of cartilaginous tumors: comparison of texture analysis with visual assessment

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Introduction: The grading of cartilaginous bone tumors is still an unsolved problem. Additionally to histology, radiologic evaluation is often the key for treatment decisions.
Methods: A single center retrospective study was performed to assess (1) the diagnostic accuracy for grading of chondrosarcoma by expert readers, (2) independent and reproducible MR-features for visual grading of cartilaginous neoplasms and (3) the diagnostic accuracy of MRI-based texture analysis (TA) in comparison and in combination with visual MR-analysis.
Results: This study included 101 Patients (50 male, 51 female) with a mean age of 48.1 ± 17.8 years (range: 15–88 years). The cartilaginous neoplasms consisted of 44 benign tumors (37 enchondromas and 7 periosteal chondromas), 23 low-grade chondrosarcoma and 34 high-grade chondrosarcoma (22 grade 2/3 and 12 dedifferentiated chondrosarcoma). The cartilaginous neoplasms were located in the femur (n = 33), humerus (n = 24), pelvis (n = 15), tibia (n = 13), scapula (n = 9), fibula (n = 3), sternum (n = 2), radius (n = 1) and ulna (n = 1). Our models identified in MRI four independent predictors for grading of cartilaginous neoplasms consisting of bone marrow edema, soft tissue mass, maximum tumor extent and active periostitis. Similar to visual MR-analysis, only significant TA features of univariate analysis with ICC-values of 0.6 or above were included into regression models to preserve reproducibility. Mean inter-reader agreement of MR- and TA-features were 0.49 (range: 0.08–0.82) and 0.79 (range: 0.43–0.99) respectively. Diagnostic accuracies for differentiation of benign and malignant as well as for benign and low-grade cartilaginous lesions were 93.2% and 93.9% using a combined model of MR- and TA-predictors, 89.5% and 78.7% using MR-predictors or 90.5% and 91.9% using TA-predictors exclusively. For differentiation of low-grade from high-grade chondrosarcoma no significant independent TA-predictors existed, whereas a model containing MR-predictors exclusively had a diagnostic accuracy of 87.4%.
Conclusions: TA shows substantial higher inter-reader reliability compared to visual MRI analysis. A model combining visual MR- and TA-features showed a higher diagnostic accuracy for differentiation of benign from malignant as well as for differentiation of benign from low-grade cartilaginous lesions compared to models using exclusively MR- or TA-predictors.

FM18

Dual-energy computed tomography (DECT) imaging for characterization and quantification of hemosiderin deposits in tenosynovial giant cell tumours (formerly pigmented villonodular synovitis). A prospective study

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Introduction: Tenosynovial giant cell tumour (TGCT), is a rare articular tumoral condition of unclear aetiology. It mainly affects the knee and can present in a localized or diffuse pattern. Treatment is usually surgical, although targeted therapies with CSF1R inhibitors show promising preliminary results. Diagnostic work-up may be challenging due to deep and intra-articular location; core needle biopsy may be at risk of neurovascular damage or seeding. Dual-energy computed tomography (DECT) is a novel imaging technique that allows material-specific characterization and quantification in tissues, hence iron detection, quantification and mapping in hemosiderin deposits of TGCT. The aim of this study was to determine sensitivity, specificity, and diagnostic accuracy of DECT for hemosiderin deposits.
Material & methods: Seventeen consecutive patients with knee masses on MRI were prospectively included in the study. Ten patients (5 males, mean age 38.6 yo) with biopsy- and/or surgically-proven TGCT and 7 control patients with other joint masses (7 males, mean age 37.1 yo) underwent single-source DECT scan using a rapid tube-voltage-switching technique. One blinded radiologist identified and quantified hemosiderin deposits using a specific post-processing software.
Results: All 10 TGCT showed iron deposits on DECT and contained hemosiderin foci at histopathology. Iron concentration ranged from 0.5 mg/mL to 14.6 mg/mL with a mean of 6.6 mg/mL. Among the 7 control joint masses (3 lipoma arborescens, 2 vascular malformations, 1 reactive arthritis and 1 osteochondroma), iron concentration ranged from 0.0 mg/mL to 15.0 mg/mL with a mean of 2.6 mg/mL. When DECT positivity threshold for intralesional hemosiderin was set to 2.0 mg/mL, sensitivity and specificity were 0.50 (95% CI, 18.7 to 81.3) and 0.57 (95% CI, 18.4 to 90.0) with a calculated accuracy of 0.53. Lowering the DECT positivity threshold to 1.0 mg/mL yielded better diagnostic performance with sensitivity and specificity at 0.80 (95% CI, 44.4 to 97.5) and 0.57 (95% CI, 18.4 to 90.0), increasing calculated accuracy to 0.71.
Conclusion: DECT-based measurements of hemosiderin deposits in intra-articular knee masses are only moderately accurate but may have diagnostic value in characterizing and quantifying hemosiderin in intra-articular masses, such as TGCT. In light of novel targeted non-surgical treatments, DECT may provide a valuable clinical tool to monitor therapeutic response.

FM19

Osteofibrous dysplasia with rhabdoid elements in a 38 year old man with spontaneous regression over 6 years

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Introduction: Osteofibrous dysplasia (OFD, Campanacci lesion) is a rare benign fibro-osseous lesion. The progression of OFD-like adamantinoma to classic adamantinoma has been shown in a few patients. The treatment because of the possible association with adamantinoma is controverially discussed; e.g. aggressive radical extraperiosteal excision was considered indicated [1], while spontaneous regressions are also well known. With the presentation of

this case we want to draw attention for a careful cautious approach to the treatment of OFD.
Patient: The 38 year old patient presented a multifocal partially confluent lesion in the proximal meta-diaphysial region of the proximal left tibia incidentally found following a knee distorsion. The 99mTc-Bone scan presented a high uptake in the perfusion as well as in the late phase. Tru-cut biopsy remained unclear and was followed by open biopsy exhibiting the image of osteofibrous dysplasia / intracortical admanatinoma with the rhabdoid variant of keratin-expressing cellular component [2]. Because of the fact, that the lesion was incidental finding it was decided to observe the further development. Images (X-Ray and MRI) 7 months after the biopsy showed impressive regression of the changes with practically complete normalisation 5 years later.
Discussion: Treatment of osteofibrous dysplasia should be carefully weighed. In the first author's experience spontaneous regression has been observed in several untouched cases in infants, while touching OFD even only by small biopsy may activate the process. The presented case is of interest for several aspect: the rare presentation of OFD with rhabdoid differentiation, the rather high age of the patient at presentation and finally the complete regression after biopsy.

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FM20

Cryoablation of extra-abdominal desmoid tumors: a 5-year retrospective case series

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Introduction: Despite the fact that extra-abdominal desmoid tumors (EAD) are not malignant, they remain challenging to treat because of their high local recurrence rate. A wide range of treatment options including observation, surgery, radiation therapy and chemotherapy have been proposed to achieve local control. The aim of the study was to evaluate the risks and benefits of cryoablation as an alternative treatment option.
Methods: We reviewed the database of our sarcoma centre to identify patients with EAD tumors treated by cryoablation between June 2011 and June 2016. Six patients were treated in 10 sessions. Contrast-enhanced MRI was used before cryoablation and at last follow-up examination. Any residual enhancement of the tumor was considered viable EAD tumor and was measured in volume by a single radiologist (GS).
Results: There was one male and seven female patients. Mean age was 35.3 years (19–66 yo). Mean follow-up was 15.9 ± 11.9 (SD) months. The cryoablation was performed percutaneously in 8 cases (80%). Some degree of volume reduction was evident at last follow-up after 8 procedures (80%). Residual tumor was observed in all cases but the disease progressed in only 2 cases (20%). One patient suffered a major complication with iatrogenic lesion of the common peroneal nerve after a percutaneous procedure in the calf; final treatment in this patient after local progression necessitated surgical treatment combined with nerve grafting and tendon transfer.
Conclusion: Cryoablation performed percutaneously or in combination with an open surgical approach is a valid alternative to achieve local control in some selected EAD tumors. Local failure is similar to the other treatment alternatives with failures rates ranging from 22 to 35% according to Wood et al. To lower the risk of iatrogenic lesion, open approach can be taken into account to protect nearby neurological or vascular structures.

FM21

Extra-abdominal desmoid tumors – from watchful waiting to extensive surgery: Results of different treatment modalities in Switzerland

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Introduction: Extra-abdominal desmoid tumors (DT) are benign and rare with a persistent treatment dilemma due to their high recurrence rate and their heterogeneous behavior. In the past wide local excision was the usual treatment, however the risk of local recurrence was high (>40%). The goal of this retrospective study is to evaluate the results of different treatment modalities for extra-abdominal desmoid tumors.
Patients and methods: 99 patients with DT were initially treated with surgery (n = 46) or surgery with radiation (n = 16) in four Swiss clinics between 1970 and 2013. Further alternative initial treatment options were radiation alone (n = 9), systemic treatment (n = 13) or watchful waiting (n = 15). Patient demographics, tumor site, histology, history of previous recurrences and follow-up status with status of disease and recurrence rates of the different treatment modalities until December 2015 were recorded retrospectively.
Results: All patients (63% female; mean age 38 years, range 16–79) presented with primary tumors while there was a mean follow-up of 8.4 years (range 1.7–44.5 years). After primary surgical treatment, 50.0% developed a recurrence. 37.5% of the group treated with surgery and radiation presented a recurrent DT. The patients who received radiation alone presented all regressive (33.3%) or stable disease (66.6%). 46.2% of the patients with systemic treatment showed progression. In patients with watchful waiting 66.6% stable disease, 22.0% spontaneous regression and 13.3% progression were observed with a follow-up of 3.9 years (2.0–11.5).
Conclusions: The results could encourage not to initially treat DT with surgery, but to wait with careful observation. Besides surgery, radiation is an additional treatment option for better local control. Systemic treatment has achieved a similar rate as the therapy with surgery plus radiation. The result of this study should be the basis for clear guidelines to create a therapeutical strategy for patients with extra-abdominal desmoid tumors in Switzerland.

FM22

Intraoperative O-arm navigation: a useful tool in the surgical management of pelvic tumours – Preliminary results

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Introduction: Bone tumours of the pelvis are difficult to treat, mainly due its complex anatomy. Surgical excision remains the mainstay of treatment, and adequate margins in sarcoma excision are mandatory for local control. O-arm (Medtronic) is a mobile "Cone Beam Computed Tomography" device. It was developed for 2D and 3D intraoperative imaging without necessity of moving patients to the radiology department. It can be coupled to navigation systems.
We present preliminary results after introduction of O-arm navigation in the management of pelvic tumours.
Material & Method: In 2016, O-arm navigation was used in 4 patients with a pelvic tumour: a recurrent sacral chordoma, a giant cell tumour (GCT) of ischium, a low grade chondrogenic tumour of sacroiliac joint and a benign fibrous histiocytoma of acetabulum extending to ischium and sacroiliac joint. O-arm navigation system was used to navigate sacral and ischiopubic osteotomies in recurrent chordoma and GCT, to monitor the extension of curettage in chondrogenic sacroiliac tumour and fibrous histiocytoma, and for sacroiliac screw fixation in the sacroiliac chondrogenic tumour case.
Results: There was no intraoperative technical or surgical complication due to the use of O-arm. Operating time was prolonged by 30–60 minutes due to the handling of the O-arm by a dedicated technician. Operation time saved due to the navigation system could not be determined. Two or 3 sequences were necessary, one for initialisation of navigation, and 1 or 2 for control of osteotomy/curetage. Mean CT dose index (CTDI) was 42.5 mGy (27–56) and mean total dose length product (DLP) was 682 mGycm (432–900). As a comparison, DLP for a pelvic bone CT (single sequence) is ~260 mGycm. The operators were not subjected to any irradiation. Osteotomies were wide and curettage was complete in all cases. There was no post-operative complication in relation to the use of O-arm.
Conclusion: Although the use of O-arm is time consuming and needs dedicated technicians and operating room, it represents a valuable help for guidance of osteotomies and curettage in tumours. Moreover, it allows navigation of orthopaedic and neurosurgical devices implantation. More cases, comparison with a non-navigated control group and a longer follow-up are needed to determine the real impact of the O-arm navigation on surgical proceedings, complications and oncological outcomes; however its use seems promising in selected cases, particularly in pelvic tumours.

FM23

Double-plate compound osteosynthesis for pathological fractures of the proximal femur

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Pathological fractures of the proximal femur due to bone metastasis have increased substantially over the last decades. Different treatment options have been described, such as intramedullary nailing, endoprosthetic reconstruction or plate osteosynthesis with or without adjunct of methylacrylate. Another technique, known as the compound osteosynthesis, has shown to be a viable method for treatment of those pathological fractures. This particular technique comprises the use of a blade plate in conjunction with a second intramedullary device in combination with bone cement.
Objectives: Evaluation of (1) long term survivorship, (2) complications, (3) functional outcome and (4) risk factors for failure of composite compound osteosynthesis.
Methods: Based on our institutional digital database, we identified 129 patients (158 procedures) undergoing a compound osteosynthesis for any type pathological fracture. 148 procedures (in 120 patients) were done in anatomical locations including the upper and lower extremities. Of those 75 procedures were done in upper extremity, tibia or distal femur. This left 73 procedures (in 65 patients) involving the proximal femur. 12 patients were treated with another technique than compound osteosynthesis. This left 61 procedures in 53 patients for final evaluation. (1) The survivorship of the hip was calculated using the Kaplan-Meier survivorship analysis (endpoints: implant failure). (2) Complications were graded using Sink's classification. (3) The functional outcome was quantified with the Merle d'Aubigné and Postel score. (4) Risk factors were identified based on a multivariate Cox-regression analysis.
Results: The cumulative Kaplan-Meier survivorship of the compound osteosynthesis was 85% at 1 year (95% CI: 72–97%), 77% (61–92%) at 2 years, 55% at 5 years (48–89%), 10 and 20 years. The number of total complications was 33 (62%), with 10% implant failure. The mean Merle d'Aubigné score was 14 ± 7 at 0–3 months, 13 ± 3 at 3–6 months, 15 ± 3 at 6–12 months and 15 ± 4 thereafter. There were no differences for among all groups (p = 0.54) or between the different time intervals. The only multivariate negative predictor was previous surgery. We did not find any association with age, sex, type of primary carcinoma, the use of neo-adjuvant chemo- or radiotherapy and type or localization of the fracture.
Conclusion: Compound osteosynthesis seems to be a valuable option for treatment of pathological fractures of the proximal femur.

FM24

Knee arthroplasty after failure of osteoarticular tibia allografts in adults. Problems and complications

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Rationale: Allografts allow to reconstruct defects of tumor resection one-to-one. In long-term survivars the osteoarticular region of allografts will almost always fail due to loss of cartilage vitality. We wish to address the problems encountered with resurfacing knee arthroplasty in these patients.
Materials and Methods: Of 5 patients reconstructed with massive proximal osteochondral tibial allografts, 4 patients are long-term survivors. One of these patients treated for a EWING sarcoma at age 10 years still has a fully functioning vital appearing proximal tibia allograft 20 years later. 3 patients with osteoarticular tibia replacement needed treatment for degeneration of their joints 10, 11, and 24 years after the initial treatment for proximal tibia osteosarcomas.
Results: Two of the three patients requiring knee arthroplasty were treated with standard resurfacing that failed within 3 years due to fracture of the allograft and instability of the non-hinged joints. They were revised to tumor reconstruction systems (MUTARS®) with fully rotating hinged knee replacements resulting in stable well function of their legs. In a third patient treated with a hemicondylar osteoarticular allograft needing knee replacement 24 years after initial reconstruction, based on the experience with the patients reported above, a fully constrained resurfacing knee arthroplasty system with stem extensions (MUTARS®) was implanted. The definitive solutions with fully constrained reconstruction systems anchored to vital host bone have definitely improved the patients' quality of life with stable full weight bearing and long-term knee arthroplasty function.
Conclusion: From our experience with massive allografts we would reserve replacement of the proximal tibia with osteoarticular allografts primarily for very young growing patients. Replacement by allograft versus endoprosthesis as initial procedure for reconstructions has to be carefully weighed against either system. Fixation of standard resurfacing knee arthroplasty on osteoarticular allografts appears prone to failure. Therefore replacement with a constrained system anchored in vital bone is needed.

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FM25

LUMIC Endoprosthesis in periacetabular tumors. Observations and problems encountered in 4 patients

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Introduction: The LUMIC modular acetabular system allows hip joint reconstruction in periacetabular tumors, if the iliac bone close to the sacro-iliac joint can be preserved. We present our observations in 4 patients.
Methods: Two patients with metastases from renal cell carcinoma are presented, in whom extensive extralesional resection was performed with curative intention. The other two patients were treated for hip destruction following radiotherapy. 1. Male, age 65 years: 6 months following left nephrectomy a metastasis of the right acetabulum between the lower border of the sacro-iliac joint and the pubic and sciatic bone was detected. The metastasis could be resected R0 en bloc with the hip joint and reconstructed with a LUMIC. The patient presently 5 years later is diseasefree and has minimally reduced hip function. 2. Female, age 60 years: 4 months following local resection of renal cell carcinoma, she presented with a large metastasis of the left iliac bone. The metastasis could be resected R0 en bloc with the hip joint and reconstructed with a LUMIC prosthesis. Intraoperatively the cone could not be anchored in the iliac bone and had to be inserted into the sacrum. At 1 year, the patient walks well using two canes outdoors. However the cone had rotated, while articulation is still maintained. 3. Female, at 14 years of age resection of the pubic part of the right acetabulum because of invasion of a rhabdomyosarcoma. Besides chemotherapy the patient received radiotherapy. At 29 years she developed rapid destruction of the hip joint, which was treated with an uncemented cup. Because of loosening 3 years later this was revised with a cemented LUMIC cone. This again loosened after 3 years and was salvaged with a acetabular cage. 4. Male, aged 53 years: fracture dissociation of the acetabulum 5 years after irradiation of the proximal right femur and acetabulum for metastasis of prostate carcinoma. The patient was treated by a cemented femoral component and a cementless LUMIC anchored in non-irradiated iliac bone.
Results: In two patients the LUMIC cone loosened. In one case this was explained by insufficient stability in irradiated bone, in the other anchorage was insufficient in the sacrum.
Two patients have excellent results with one patient at 5 years follow-up.
Conclusion: Inspite of short-comings the LUMIC endoprosthesis appears a viable option for the reconstruction of the hip joint in large periacetabular defects due to primary tumors or metastases.

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*FM26

Arthroscopic correction of the critical shoulder angle through lateral acromioplasty: a safe adjunct to rotator cuff repair

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Introduction: A large critical shoulder angle (CSA) is an established risk factor for rotator cuff tearing (RCT). CSA reduction experimentally diminishes the load on the supraspinatus and reduction of a large CSA should clinically have the potential to reduce chronic repetitive (over-) loading of the supraspinatus. A safe and reliable operative technique to reduce CSA is not yet described. It was the purpose of this study to test the hypotheses that arthroscopic lateral acromioplasty reliably allows to decrease a large CSA, that it does not jeopardize the deltoid

origin or cause other complications and that it is associated with a RC repair (RCR) outcome which justifies further prospective, comparative investigation.
Methods: Forty-nine consecutive patients with degenerative full-thickness RCTs and a CSA of ≥34˚ underwent combined arthroscopic RCR with lateral acromioplasty. The mean age was 59 (range, 41–78) years. All patients underwent clinical and MRI evaluation preoperatively and at a mean follow-up of 30 (range, 12–47) months.
Results: There were no intraoperative complications and seven structural RC tendon repair failures (14%). The mean preoperative CSA was reduced from 37.5˚ (range, 34˚–44˚) to 33.9˚ (range, 30˚–38˚; p <0.001). At follow-up there were neither dehiscence nor fatty infiltration nor atrophy of the deltoid. Eighteen patients (37%) had minor scarring at the deltoid origin without discontinuity. Absolute and relative mean Constant scores improved from 59 (range, 10–92) to 74 (range, 37–92) points (p <0.001) and from 66 (range, 12–96)% to 83 (range, 49–100)%; (p <0.001). Mean SSV increased from 45 (range, 5–85)% to 80 (range, 20–100)%; (p <0.001). Postoperative CSA was significantly larger in failed than in healed repairs (p = 0.026).
Conclusion: Arthroscopic lateral acromioplasty can reduce the CSA without compromising the deltoid origin or muscle. In this series, a small postoperative CSA was associated with a low retear rate. Prospective randomized trials comparing RCR with and without lateral acromioplasty appear warranted.

FM27

Transplantation of micro-tissues in rotator cuff muscle with the onset of tendon release: A feasibility study on therapeutic effects

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Introduction: An increase in the muscle stem cell reservoir during tendon repair may halt muscle to fat conversion and allow regeneration of ruptured muscle. We investigated whether autologous mesenchymal stem cells promote myogenesis and prevent fat accumulation subsequent to tenotomy and repair of rotator cuff muscle.
Methods: Mesenchymal stem cells were harvested, enriched, grown as hanging drops into micro-tissues and labelled by fluorescent nano particles (QTrackers). Infraspinatus muscle of the right shoulder was released by osteotomy in 6 Swiss Alpine sheep. 16 weeks later, autologous micro-tissue was injected and serum injection served as control. Afterwards, the muscle was reattached and sheep were allowed to recover for 6 weeks. Biopsies from micro-tissue-injected, serum-injected and untreated areas of the reattached muscle and contralateral infraspinatus muscle were processed to quantify the area percentages of muscle, fat, connective tissue and micro-tissue, mean cross sectional area (MCSA) of muscle fibers, and expression of myogenic and adipogenic markers. Muscle volume and fat composition was determined from MRI and CT-based imaging. Differences in variables were assessed with paired T-test.
Results: 6 weeks after reattachment, muscle mass and MCSA was lower compared to contralateral infraspinatus, i.e. 165.2 vs. 220.5 cm^3 and 5158.1 vs. 5896.8 $micrometer^2$, and fat content increased from 2.1% to 9.4%. In the injected area micro-tissue constructs were readily detected using Q tracker as 'follicle' like structures. 6% of Qtracker positive cellular structures resembled myofibers, the MCSA of half of which exceeded 300 $micrometer^2$. The area percentage of endomysial fat percentage in serum- and micro-tissue-injected areas increased compared to untreated areas, i.e. 12% and 15% vs. 3%. The presence of micro-tissue did not affect endomysial (p = 0.32) and perimysial fat (p = 0.53), nor slow (p = 0.41) and fast type fibers (p = 0.68) relative to serum-injected areas. It had also no effect on the myogenic markers, myogenin and tenascin-C, and the adipogenic marker PPARG. Expression of tenascin-C correlated with perimysial fat percentage (r = 0.75).
Conclusions: Injected mesenchymal stem cells can grow into muscle fibers but the incidence of this event is low and overall does not enhance the myogenic potential. The selected route of stem cell administration is insufficient to halt fat accumulation subsequent to repair of the ruptured rotator cuff in sheep.

FM28

Pilot evidence for a genetic influence on the critical shoulder angle and re-rupture rate of the torn rotator cuff

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Introduction: A critical shoulder angle (CSA) above 30° is a decisive biomechanical parameter being tied to the incidence of primary rotator cuff tendon rupture. Single nuclear polymorphisms (SNP) in genes being associated with mechano-regulation of the muscle-tendon-bone unit represent potential factors which determine the CSA and re-rupture of the repaired shoulder cuff muscle.
Methods: 51 patients of the shoulder clinic with a single or combined rupture of the supraspinatus tendon were included in this retrospective study. Patients were assessed for shoulder function before, 3 and 12 months after reconstructive surgery. Rupture and re-rupture were confirmed based on clinical examination and magnet resonance imaging. CSA was evaluated using standard criteria on recorded X-ray images. Genotype was determined for selected SNPs within the tenascin-C (rs2104772), actinin-3 (rs1815739) and focal adhesion kinase (rs7460, rs7843014) gene using high resolution melt polymerase chain reaction on genomic DNA as extracted from drawn blood.
Results: All subjects demonstrated CSA values beyond 30° (35.3 ± 0.6°). 8 patients demonstrated tendon re-rupture within the first 3 months after reconstructive surgery. The re-rupture rate or CSA was not associated with a single genotype. The combination of SNPs rs2104772 and rs1815739 affected CSA-values (p = 0.018, ANOVA). This effect was explained by differences between carriers vs. non-carriers of the A-allele of SNP rs2104772 in the CC-genotype of SNP rs1815739. Thereby A-allele carriers demonstrated a 7° higher CSA than non-allele carriers (i.e. AA/AT: 38.4°/38.7° vs. TT 31.8°) and tended to demonstrate a higher chance of re-rupture (p = 0.08, Chi2).
Conclusion: We find pilot evidence for an association between the CSA and the re-rupture rate of a repaired rotator cuff tendon with two genetic factors that may influence functional properties of the muscle-tendon unit. Future investigations should aim to confirm the association in a large cohort, test the association of the criteria with the initial rupture and invest in exposing the implicated biological pathway.

FM29

A SSP tear repair with porcine dermal xenograft augmentation may not benefit patients in terms of reducing the risk of recurrent tendon defect or improvement in shoulder function.

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Introduction: We investigated the 2-year postoperative clinical and subjective outcomes after arthroscopic rotator cuff repair (ARCR) with xenologous porcine dermal patch augmentation compared to ARCR alone.
Materials and Methods: Using a cohort study design, we compared a consecutive series of 20 patients aged 60 years or older with a supraspinatus (SSP) tendon tear who underwent ARCR using a transosseous equivalent technique and xenologous porcine dermal patch augmentation (patch group) with 20 patients matched by tear size who received ARCR only (control group). Patients reported daily pain levels for 10 days after surgery. Clinical parameters and various patient-reported outcome scores were documented preoperatively and at 3, 6 and 24 months post-surgery. Repair integrity was determined by two assessors using MRI or ultrasound at 24 months. Adverse events were recorded. Group outcome differences were analyzed using t-tests, Fisher's exact tests and mixed models.
Results: Patch patients had slightly more SSP fatty infiltration preoperatively. At 24 months, 9 and 4 patients were diagnosed with a recurrent SSP tendon defect in the patch (n = 19) and control (n = 20) group, respectively (Relative Risk = 2.4; p = 0.096). Of 11 (85%) defects identified as medial cuff failure, 8 occurred in the patch group. Pain rated by all patients decreased from postoperative day 1 to 10 without any significant group difference (p = 0.348). No significant group differences were noted for other outcome parameters, and recurrent defects had no relevant effect on functional outcomes. Twelve and 8 patients experienced a local complication (including recurrent defects) in the patch and control group, respectively (p = 0.343).
Discussion/Conclusion: A SSP tear repair with porcine dermal xenograft augmentation may not benefit patients in terms of reducing the risk of recurrent tendon defect or improvement in shoulder function.

FM30

Partial subscapularis tears – should we repair?

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Introduction: Supraspinatus (SSP) tears are often associated with a partial superior third lesion of the subscapularis (SSC) tendon. There is no consensus on whether these partial lesions should be treated or not. This retrospective study compared the clinical and subjective outcomes of SSP repair patients treated with or without repair of an associated superior SSC partial tear.
Methods: From our rotator cuff register, we included all patients with a SSP repair and a documented partial (Lafosse I) tear of the superior SSC tendon. Patients with and without a repaired SSC tear were distributed into two groups. Baseline and operative data as well as clinical and patient-rated outcomes of the Constant Score (CS), Oxford Shoulder Score (OSS), Subjective Shoulder Value (SSV) and satisfaction at 6- and 24-months post-surgery were compared between the groups. Mixed models were used to adjust for baseline differences in age and gender.
Results: Of 47 patients with a minimum of 6-month follow-up data, 31 did not undergo SSC repair versus 16 SSC repairs with one suture anchor. All but one patient in each group had a treated biceps tendon. Surgery time was significantly shorter in the non-repair group by 30 minutes ($p = 0.001$). Patients with a SSC repair were younger and had better baseline function. At 6 months, the mean CS was similar in the non-repair [71.2 points (SD 14.3)] and repair groups [73.9 points (SD 11.3)] ($p = 0.537$) as well as the outcome of OSS [37.2 points (SD 11.0) vs. 35.6 (SD 9.5), respectively]. Gains in strength [2 kg] and internal rotation at 90° abduction [3°] were significantly greater in the non-repair compared to the repair group [–0.6 kg and –21°, respectively] ($p \leq 0.015$). The mean 6-month SSV [85.3% (SD 12.3)] and its mean change from baseline [39.1% (SD 22.2)] were also significantly higher in the non-repair than repair group [71.2% (SD 20.7) and 20.2% (SD 16.6)] ($p \leq 0.015$). Differences in subjective outcomes persisted up to 24 months. Patients in the non-repair group appeared to be more satisfied with their shoulder condition.
Conclusion: There was no overall significant difference in clinical outcome between the groups at 6 and 24 months, although the repair group had better baseline function. Despite the limited patient numbers, these observations do not support the repair of Lafosse I SSC tendon tears.

FM31

The greater tuberosity angle, a predictor for rotator cuff tears

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Introduction: Association of acromion shape and rotator cuff tears has been extensively studied. However, impingement inherently involves two bony structures, and no study has yet analyzed the role of the greater tuberosity (GT). We describe a new radiographic marker, the Greater Tuberosity Angle (GTA), that measures that measures position of the GT relative to the center of rotation of the humeral head. The hypothesis was that a higher angle value was associated with a higher risk of rotator cuff tear.
Methods: Between August 2015 and July 2016, two population groups were prospectively recruited from a specialized shoulder clinic. Patients consisted of subjects presenting with a degenerative rotator cuff tear shown on MRI scan. Isolated subscapularis and traumatic tears were excluded. Controls consisted of subjects presenting with any other shoulder condition and no rotator cuff pathology. In both groups, subjects with degenerative or post-traumatic deformity of the humerus were excluded. The GTA was measured on a standard anteroposterior shoulder radiograph with the arm in neutral rotation by three different observers at two timepoints.
Results: 71 participants were recruited (33 Patients, 38 Controls). GTA was significantly higher in Patients than Controls (72.5° ± 2.5, range 67.6–79.2, versus 63.8° ± 4.1, range 55.8–70.5; $P < 0.001$). A value above 70° increased the odds of detecting a tear by 93 fold ($P < 0.001$), with the lowest rate of false-positives (5%) and false-negatives (9%).There was no correlation between GTA and patients characteristics, such as age, dominance, affected side, sex, tear size, and pain duration. Inter- and Intra-observer reliability testing were high (concordance rho ranges = 0.925–0.956 and 0.904–0.947, respectively).
Conclusion: A higher Greater Tuberosity Angle is associated with an increased risk of rotator cuff tear, with above 70° being a reliable predictive cut-off value.

FM32

Clinical and structural outcome of immediate arthroscopic repair of acute massive rotator cuff tears with pseudoparalysis for elevation and external rotation

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Introduction: Massive acute traumatic rotator cuff tears (at least 2 tendons) with pseudoparalysis can lead to permanent crucial limitations and are still therapeutically challenging injuries. Early repair may reliably restore function and may prevent from developing rotator cuff arthropathy ending in reverse total shoulder prosthesis.
Methods: Between June 2011 and December 2014 twenty-one consecutive patients (15 men, age 30–83 y, 6 women, age 50–80 y) with a relevant shoulder trauma resulting in a massive rotator cuff tear (RCT) and pseudoparalysis for elevation (and external rotation) were included. None of the patients had shoulder pain or impairment before the trauma. All tears were repairable according to X-ray and MRI criteria. All patients underwent early arthroscopic repair, regardless of age. After a minimum of two years patients were reviewed clinically, including Constant score (CS) and subjective shoulder value (SSV), and with MRI.
Results: Intraoperative evaluation of rotator cuff showed that 6 patients had tears of two tendons, 14 patients of three tendons and one patient of four tendons. Ten patients had shoulder dislocation (7 men, 3 women), and 11 an adequate trauma but no dislocation (8 men, 3 women, $p = 0.89$). At final follow-up all patients hat complete reversal of the pseudoparalysis. The SSV (mean 94, range 50–100) and CS (mean 82, range 56–95) did not significantly differ compared to healthy opposite side. At final follow-up the MRI revealed a re-tear of one tendon in 1 of the 20 cases, and re-tear of two tendons in 3 of 20 cases (overall retear rate 20%). Subjective shoulder value, Constant score and relative Constant score did not differ significantly between the group with and without re-tear. The group with re-tear was older (mean 71y) than the group without signs of re-tear in the MRI (mean age 59y). However, this difference was not significant (Wilcoxon test $p = 0.19$). There was no correlation between the age and change of the grade of fatty infiltration between the preoperative and follow-up MRI examination.
Conclusion: Our study shows that acute massive RCTs presenting with pseudoparalysis can successfully be treated with early arthroscopic repair regardless of the age. If patients were asymptomatic before the injury, complete restoration of function with reversal of the pseudoparalysis can be reliably achieved. The retear rate is low and the increase of fatty infiltration is minimal.

FM33

A biomechanical comparison of different suture materials commonly used for arthroscopic shoulder procedures

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Introduction: Although many other factors affect the success of rotator cuff repairs, the viscoelastic properties of sutures may be a useful predictor of suture performance. The purpose of this study was to evaluate the viscoelastic properties of 6 suture materials, commonly used in arthroscopic rotator cuff repairs, when subjected to physiological loads.
Methods: We evaluated 6 commercially available No. 2 sutures undergoing creep (n = 7, 60N, 10 min) testing to determine specimen stiffness, initial extension at 60-N load, total static creep (during 10 minutes loading), and relaxed elongation (material recovery 3 minutes after removal of load). Furthermore, cyclic (n = 7, 10-45N, 0.5 Hz, 500 cycles) testing was carried on to determine dynamic creep, peak-to-peak displacement (displacement between peak and trough of loading cycle) and relaxed elongation. Mechanical testing was conducted on a material testing machine (Instron, Nordwood, MA) in phosphate-buffered saline solution (PBS) maintained at 37 °C. The selected sutures were Ethibond (Ethicon, Somerville, NJ), FiberWire/FiberTape

(Arthrex, Naples, FL), Orthocord (DePuy, Warsaw, IN) and Ultrabraid/ Ultratape (Smith & Nephew, Memphis, TN).
Results: Regarding creep testing, FiberTape showed the greatest stiffness (23.9 ± 3.2 N/mm, P <0.001), and the smallest amount of static creep (0.38 ± 0.10 mm, P <0.001). FiberTape and FiberWire showed the smallest initial extension (1.17 ± 0.17 mm and 1.63 ± 0.25 mm respectively, P <0.001). Ultrabraid showed the largest relaxed elongation (4.73 ± 0.73 mm, P <0.001). Regarding cyclic testing, FibreTape exhibited the smallest dynamic creep (0.16 ± 0.09 mm, P <0.003), and the smallest peak-to-peak displacement (0.20 ± 0.02 mm, P <0.001). Ultrabraid showed the largest relaxed elongation (4.18 ± 0.83 mm, P <0.002).
Conclusion: FiberTape consistently displayed smaller creep properties, greater stiffness and less extensibility than the other suture types studied. Ultrabraid showed the largest amount of relaxed elongation in both creep and cyclic testing. The contribution of suture properties, such as creep, to the cuff repair construct is yet to be investigated.

FM34

Outcome of traumatic rotator cuff tear repairs

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Introduction: Traumatic rotator cuff (RC) tears lead to loss of function and pain. We report on the outcome of repaired traumatic RC injuries regarding the interval between injury and surgery, and compare these results with a matched control patient group with non-traumatic RC tears.
Methods: All patients under 50 years of age with a clear trauma of the RC and primary reconstruction were identified from our RC register. We defined 5 different trauma-until-surgery-interval groups: less than 6 weeks; 6 to 12 weeks; 3 to 6 months; 6 to 12 months; and more than 12 months. 88 patients completed the Constant Score (CS) examination at 6 months post-surgery, and 122 patients completed the Subjective Shoulder Value (SSV), Oxford Shoulder Score (OSS), and questions on perceived improvement of the shoulder condition and quality of life after 24 months. Patients with isolated supraspinatus (SSP) tears were matched by age and gender (odds 2:1) to non-trauma patients and compared based on the 6- and 24-month outcomes.
Results: Of 188 trauma patients, one-third had partial tears and 114 had isolated SSP tears. The biceps tendon was treated in 73%. Baseline scores for patients with complete ruptures were significantly worse when less than 6 weeks have passed between trauma and surgery. After surgery, the CS significantly improved for all groups, although improvement was greater for the earliest interval group. There were no differences in mean CS after 6 months (72, 70, 73, 80 and 71 points, respectively) and mean OSS after 2 years (43, 36, 40, 42 and 42 points) among the 5 groups. 112 trauma patients with SSP tears were matched with 56 non-trauma patients. The CS was similar at 6 months. After 2 years, 81% of trauma patients reported a “much better improvement” in the shoulder discomfort survey compared to 50% of non-trauma patients (p = 0.005), which was associated with a significantly higher SSV of 89.9 (SD 16) in the trauma group versus 77.8 (SD 18.8) for non-trauma patients (p = 0.003).
Conclusion: The strongest improvement was observed in patients operated within 6 weeks after trauma, yet these patients had the lowest baseline status. Patients who are not operated directly after trauma can expect a similar end result as if the surgery was done earlier, if the tear is repairable. Although trauma and non-trauma patients with a SSP repair achieved similar functional outcome, the perceived improvement of trauma patients was significantly higher after 2 years.

FM35

Isolated restriction in glenohumeral abduction as a diagnostic feature in calcific tendinitis

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Introduction: During the examination of a painful shoulder the patterns of restriction in range of motion can aid in diagnosis. In adhesive capsulitis, the anatomical changes are well correlated to the changes in motion. The pattern of restriction in calcific tendinitis is not thought to be specific to this condition. In calcific tendinitis, the most common site is within the supraspinatus tendon. The expected range loss would be in abduction and should contrast the restriction seen in adhesive capsulitis, where diffuse changes cause loss in external rotation and abduction. We hypothesize that the range of motion in calcific tendinitis would show restriction in glenohumeral abduction with preservation of external rotation when compared to adhesive capsulitis.
Methods: A retrospective database review was performed to compare the glenohumeral range of motion in patients with a diagnosis of calcific tendinitis and with adhesive capsulitis. The inclusion criterion was unilateral disease with complete documentation at presentation of range of motion with imaging to confirm the diagnosis. Patients were excluded if they had a symptomatic contralateral shoulder. The range of motion in the symptomatic shoulder was compared to the asymptomatic side. Since most data were non-normally distributed data, the median (interquartile range [IQR]) and Wilcoxon signed-rank test are given in most instances. The significance level was set at 5%.
Results: There were 313 patients identified in the calcific tendinitis group and 645 in the frozen shoulder group. There were 64 in the calcific tendinitis group and 78 in the adhesive capsulitis group who fit inclusion criteria. Median glenohumeral abduction was significantly restricted in calcific tendinitis (82 [75–90] degrees [°] versus [vs] 90 [90–100]°, p <0.001) and adhesive capsultis (53 [40–70]° vs 90 [90–90]°, p <0.001). Median glenohumeral external rotation was not restricted in calcific tendinitis (60 [50–70]° vs 60 [50–70]°, p = 0.129, paired t test), but significantly restricted in adhesive capsultis (25 [10–40]° vs 70 [60–80]°, p <0.001).
Conclusion : Isolated mild loss of range of glenohumeral abduction without loss of external rotation was found to be specific for calcific tendinitis when compared to adhesive capsulitis. This study also indicates that the pattern of loss is not global restriction in range as previously described in calcific tendinitis and if global loss is found, secondary adhesive capsulitis should be considered.

***FM36**

A method for measuring the scapulo-humeral circumduction

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Introduction: In the context of a European project entitled “CLOTHILDE” concerning the development of an innovative implant to treat humerus fractures. During the validation tests, the arm position in 3D relative to the thorax is required at all times to analyze the results. This system consists of stand-alone sensors and data post-processing software. When placed on a patient, the sensors transmit information to a dedicated software. The raw data is then filtered and processed in order to obtain the relative motion between the sensors.
Methods: Nowadays, many systems exist to identify the displacements of a solid body in 3D. The recent improvements in Inertial Measurement Units (IMU) allow to have in a small volume the necessary components to obtain sensor orientations. The device gives at each point of time the position of the vertical axis using the accelerometers through the measurement of the acceleration vector. Then the device is positioned to the north using the magnetometer information to retrieve the vector of the Earth’s magnetic field. The sensors give relevant information ($\pm1^\circ$~approximately) provided that the motion is relatively slow so as not to influence the accelerometric measurements. It is also necessary that the subject is far from any magnetic fields (motors, magnets, etc.). One of these sensors is attached to the trunk of the subject and serves as a reference. The other two are fixed on the skin on the right and left arms, in the center of the diaphysis. Several steps were necessary to obtain this device: The acquisition of raw data (8 hours of autonomy); Calculating the angular position of each sensor in relation to a fixed reference basis (Earth); The calculation of the relative positions between the various sensors in order to extract the angular data and to know the type of movement made by the arms.
Results: Within two minutes, the most relevant data that can be extracted are the angle between the arm and the trunk over time and the identification of the type of motion (flexion, retropulsion, abduction and adduction) corresponding to the circumduction.
Conclusion: The system is operational and can identify the treatment benefit on the angular range of the shoulder before and after the surgery. Many areas of application are targeted in addition to the applications of our project: detection of musculoskeletal disorders (MSDs), kinesitherapy and surgical planning.

FM37

Revision rate in total knee arthroplasty in patients with a history of intravenous drug abuse: a retrospective analysis

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Introduction: Injection drug users are at high risk for infection with blood-borne pathogens, namely human immune deficiency virus (HIV), hepatitis B and C virus as well as a variety of bacterial infections. When total knee arthroplasty (TKA) is anticipated the risk of septic complications is a major concern for orthopedic surgeons in this particular patient population. The aim of this study was to assess the clinical and radiographic outcome of patients with a history of intravenous drug use after total knee arthroplasty. The primary outcome of this retrospective analysis was revision rate. Secondary outcomes were the Western Ontario and McMaster Universities Arthritis Index (WOMAC), Knee Society Score (KSS), and the Short Form (36) Health Survey (SF-36) and radiographic loosening.
Method: We retrospectively reviewed the records of 1692 TKA performed or revised in our institution between 2005 and 2015. Data of 17 TKA in 12 patients (11 male, 1 female, age: 42.8 years, range: 23–62 years) with a history of intravenous opioid abuse were available for final analysis. Human immune deficiency virus infection was apparent in 4 cases and chronic hepatitis C infection in 9 cases, respectively. The WOMAC and SF-36 scores were administered during a study visit. Physical examination of the knee joint was performed and the KSS-score was recorded. Plain- and long standing radiographs ware obtained to exclude radiographic loosening.
Results: The mean follow up was 9.5 years (range: 1.5–19.3 years). Seven patients required revision surgery due to periprosthetic joint infection. The time until revision surgery was performed was 62.1 months (range: 5–159 months). The median prosthesis survival was 101.0 months (95% CI: 56.2–145.9 months). One patient underwent two-staged revision arthroplasty and three patients were treated with an arthrodesis of the affected joint. An above the knee amputation was required in 3 cases. The objective KSS-score was 79.2 points (range: 50–100 points) and the functional KSS-score was 83.2 points (range: 0–100 points) among patients in whom the implant was not removed. The WOMAC-score was 11.9 points (range: 0–52.1 points).
Conclusion: Total knee arthroplasty in patients with a history of intravenous drug abuse is associated with a high risk of major complications, including above the knee amputation. Hence, other therapeutic options for osteoarthritis of the knee including primary knee arthrodesis should be discussed.

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*FM38

Dynamic intraligamentary stabilization – a re-definition of indications based on a multivariate analysis

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Purpose: Primary repair of the anterior cruciate ligament (ACL) has regained interest of clinicians with recent development of novel repair techniques. Dynamic intraligamentary stabilisation was introduced in an attempt to promote healing by shielding cyclic loads acting upon the ACL during the healing phase. The aim of this study was to identify negative factors likely to influence success of this procedure.
Methods: Between 2009 and 2014, 264 patients with an acute ACL rupture undergoing dynamic intraligamentary stabilisation were included in this study. Patients were evaluated for anterior/posterior laxity; range of motion and patient reported outcome measures. Adverse events and re-operations were noted. Failure was defined as ΔAP Translation >3 mm, re-rupture or conversion to ACL reconstruction. Minimum follow-up was 24 months. Univariate and multivariate regression models were utilized to determine predictors of failure.
Results: An overall complication rate of 15.1% was noted comprising 9.5% (n = 25) re-ruptures, 4.1% (n = 11) persistent instability and 1.5% (n = 4) >10° fixed flexion deformity. Two factors were identified as negative predictors of failure: 1- Pursuit of competitive sport activities with a Tegner pre-injury score >7 (Odds Ratio (OR) 4.4, CI 1.2–15.9, p = 0.02) and 2- mid-substance ACL rupture location (OR 2.5, 1.1–5.7, p = 0.02). When neither of those risk factors occurred the failure rate was limited to 3.9%.
Conclusions: Correct patient selection and narrowing of indications is necessary to maintain high success rates of the procedure. Mid-substance ACL ruptures and a high pre-injury sports activity level are two predictors of inferior outcome.

FM39

Coronal and sagittal alignment in conventional and computer-assisted total knee arthroplasty using a novel accelerometric navigation system within the surgical field:

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KSU

Total knee athroplasty (TKA) is a well described orthopedic procedure for patients with osteoarthritis (OA) of the knee joint. Component-alignment is considered to be an important factor for successful outcome. Several computer-assisted TKA devices (CAD) were developed to improve component positioning. The aim of this study was to assess the accuracy and reproducibility of the novel Navigation System iAssist and to compare it with conventional surgery. From 04/2014 to 10/2016 we prospectively recruited 2 cohorts of 22 consecutive patients undergoing primary TKA into this study. The demographics of both cohorts were similar. The cemented Zimmer Persona TKA with the highly cross linked ultra congruent polyethylene inlay was used in all TKAs. We used the the novel imageless iAssist CAD System in the first cohort of 22 TKAs with all relevant alignment information accessible on the "PODs" and compared it with a second cohort of 22 TKAs with conventional alignment. The mean post-operative mechanical axis was 179.2° (SD ± 1.63), being 0.8 valgus with iAssist and 180.5 (SD ± 1.83) being 0.5 varus with conventional surgery. Conventional surgery was closer to our target of 180 (p = 0.017) but had 1 outlier. The anatomical axis was 172.43° (SD ± 3.99) with iAssist and 174.67° (SD 2.47) with conventional surgery (p = 0.034). The mean femoral mechanical-condyles-angle measured 90.6° valgus (range 4.1° valgus to 1.8° varus, SD ± 1.6) with iAssist and 89.7 varus (range 3.91 ° valgus to 2.82° varus SD 1.8) with conventional surgery (p = 0.454). The mean frontal tibial tray alignment was 89.8° valgus (SD ± 1.9) with iAssist and 90.8° varus (SD ± 1.5) with conventional surgery (p = 0.264). The tibial slope was 84.98° (SD ± 1.05) with iAssist and 83.17° (SD ± 2.5) with conventional surgery (p = 0.0066). The measurements were based on the Knee Society TKA roentgenographic evaluation system. The analysis of radiographs of 22 iAssist TKAs demonstrated excellent accuracy of this novel CAD System. It supports the surgeon intra-operatively to achieve the preoperatively planned frontal alignment (mechanical axis) as well as the sagital component alignment (i.e.femoral flexion, tibial slope). Our 22 TKAs with conventional extramedullary alignment for the tibia and intramedullary alignment on the femoral side in combination with measured resection and preoperative planning an whole leg x-rays demonstrated equally good alignment. We had one outlier with 4° mechanical valgus.

FM40

The stem fixation technique do influence the tibial alignment in TKA revision. A comparative study between cemented and cementless / hybrid cemented tibial stems using 3D-CT.

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Introduction: Purpose of the study was to investigate if the fixation technique for intramedullary stems in total knee arthroplasty revisions (rTKA), influence the alignment of the components, leg axis and the rates of complications, reoperations and revisions.
Methods: Sixteen patients with cemented tibial stems (Group C) and twenty-six patients with either cementless or hybrid cemented tibial stems (Group PF) were collected. All patients underwent regular clinical follow-up (41.5 months) and postoperative 3D-CT scans. Mean values of the three dimensional rTKA component position and of the leg axis were compared between groups with the T-test. The tibial components were graded on the transversal plane into internal, neutral and external rotated, and, on the coronal plane, in neutral and varus/valgus aligned. The graded measurements and the incidences of postoperative complications, reoperations and revisions were analysed with a Chi^2-Test.
Results: The mean measurements of the component position did not significantly differ between groups (p <0.05). Group C showed a tendency to internal rotation (Group C: 62.5%; Group PF: 34.6%) and a significant higher coronal alignment accuracy (p = 0.004). Group PF instead a tendency to external rotation (Group C: 25.0%; Group PF: 46.2%) (p = 0.094). Both groups presented a neutral leg alignment (Group C: 0.00° ± 3.37; Group PF: 1.04° ± 2.6) (p = 0.268). Group PF showed a tendency to more complications (Group C: 35.7%; Group PF: 60.9%; p = 0.138). No significant differences were seen between rates of reoperations (Group C: 35.7%; Group PF: 30.4%; p = 0.565) and revisions (Group C: 28.6%; Group PF: 8.7%; p = 0.894).
Conclusions: The stem fixation technique influence the tibial component alignment. A more accurate coronal alignment was achieved in Group PF.

FM41

Contribution of the gait analysis and clinical outcomes to patient satisfaction one year after total knee arthroplasty

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Introduction: About 14–28% of patients indicate non-satisfaction after total knee arthroplasty (TKA). The relation between function and satisfaction is not completely understood. The assessment of gait following TKA has been recognised as an objective and useful method to assess function in patients with knee osteoarthritis (OA) and following TKA. However, the contribution of gait outcomes on patient satisfaction one year after surgery has not been evaluated. The purpose of this study was to determine which gait and clinical one-year post-operative outcomes contribute to patient satisfaction one year after TKA.
Method: A group of 79 patients, with severe knee OA, were prospectively evaluated before surgery and one year after primary TKA using clinical gait analysis. We evaluated the following gait parameters: gait velocity, cadence, stance phase duration, stride length, step length, maximal knee flexion during gait cycle, knee range during loading response (LR), and knee range of motion (ROM), as well as the following patient-reported outcomes: WOMAC pain and function score, pain on VAS, general health (SF-12), global satisfaction, their satisfaction regarding pain relief and satisfaction regarding functional improvement. A multi-linear regression model (stepwise-forward) was used to identify which of the biomechanical or clinical 1-year outcomes were most associated with patient satisfaction.
Results: Global satisfaction reached a score of 77.2%. The multi-linear regression model illustrated that 24.6% of global satisfaction was explained by the decrease of the Knee Pain (VAS). The 1-year WOMAC pain and SF-12 mental score together explained 30.5% of the satisfaction due to pain relief. WOMAC function score, maximal knee flexion and gait speed at one year explained a total of 30.4% of the satisfaction due to functional improvement.
Conclusion: This is the first study analyzing both 3D gait and clinical outcomes to identify factors linked to patient satisfaction one year after primary TKA. Both clinical and gait outcomes improved in our cohort but gait analysis parameters alone (knee ROM and gait velocity) explained only a small amount of satisfaction. This reflects the complexity of patient satisfaction for which a part can be explained by reduction of pain and improving of function and another part by more subjective factors (e.g patient expectations).

FM42

Knee implant loosening detection: a vibration analysis investigation

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Introduction: Diagnosis of total knee arthroplasty (TKA) loosening remains a challenge for all orthopaedic surgeons but is essential, as TKA revision is expensive and has a high patient morbidity. In the present study, we propose a vibration-based system to detect the tibial implant loosening.
Methods: We developed a system made up of a vibration shaker stimulating the tibia through the skin (input signal) and accelerometer sensors fixed to the tibial component measuring vibrations propagated through the bone and the bone-implant interface (output signal). The input signal was measured by an accelerometer and a force sensor present at the tip of the shaker. These latter allowed us also to monitor the contact between the instrument and the leg which was essential to provide the repeatability of experiment conditions. A prosthetic tibial component was implanted and cemented in fourteen cadaver lower limbs. Harmonic-forced vibrations were then applied on the tibia and the signal was measured at the level of the tibial component. Same measurements were performed after tibial implant loosening which was characterized by macroscopic movements secondary to cement removal. Coherence between input and output vibration signals was computed in the excitation frequency range. The correlation between the obtained coherence and the baseline coherence, which represented the secure implant conditions, was then used to detect a loosened from a secure implant.
Results: The coherence correlation between repeated measurements of secure implant was 0.87 ± 0.19. However the coherence correlation between the corresponding secure and loosened implants was 0.60 ± 0.15. According to our data, the optimal coherence correlation threshold to discriminate between a loosened and a secure tibial implant was 0.82. Using this threshold the present method could diagnose a tibial implant loosening with a respective accuracy, sensitivity and specificity of 92.3%, 91.7% and 92.9%.
Conclusion: This study represents an encouraging step towards the integration of sensors in prosthetic implant to optimize the follow-up of our patients who have undergone a total knee replacement. However, further studies need to be performed to confirm our results.

FM43

The type of approach does not influence TKA component position in revision total knee arthroplasty – a clinical study using 3D-CT

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Introduction: To investigate if the medial parapatellar approach (MPA) and lateral parapatellar subvastus approach with tibial tubercle osteotomy (LPA) influence the position of the prosthetic components and leg alignment in revision total knee arthroplasty (rTKA).
Methods: Forty-two consecutive patients underwent rTKA with either MPA (n = 21) or LPA (n = 21) because of loosening, infection, malposition or instability. The component position and leg alignment were assessed on 3D reconstructed CT images and compared between groups with the T-Test ($p < 0.05$). The prosthetic components were graded as internally, neutrally and externally rotated according to a previously used schema and a Chi^2-test was performed. Postoperative complications, reoperations and revisions rates have been collected and compared with a Chi^2-test.
Results: Group MPA and LAP did not differ on the three planes with respect to the femoral component (coronal: 0.62° Vs 0.90°; sagittal: 7.48° Vs 7.67°; transversal: 0.38° Vs –0.19°), to the tibial component (coronal: 0.05° Vs 0.29°; sagittal: 3.05° Vs 1.62°; transversal: 6.90° Vs 9.33°) and to the leg alignment (varus: 0.24° Vs 1.05°). Group LPA showed a not significant higher incidence of neutrally (28.6% vs 9.5%) and less internally (23.8% vs 38.1%) rotated tibial component ($p = 0.254$). No significant differences were seen between rates of complications ($p = 0.236$), reoperations ($p = 565$) and revision ($p = 0.715$).
Conclusions: No significant differences were seen between the groups. The similar tibial rotations, known to depend from the approach at TKA, could be explained with the use of intramedullary and extramedullary alignment rods in every patient.

FM44

Patient reported outcome measurements in total knee arthroplasty risk-benefit assessment: comparing a newer with an older design

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Introduction: The upcoming European device regulation will consider even minor changes in total joint designs for premarket authorization. To improve the risk-benefit assessment, identify designs with superior outcomes and avoid potential failures as early as possible, PROMs are an important additional outcome to consider, with revision and complication rates and costs. We compared PROMs and patient satisfaction 1yr postoperative, in patients with a newer and an older posterior-stabilized (PS) TKA design from the same brand.
Materials and methods: Hospital-based arthroplasty registry prospective cohort study including all Attune and PFC Sigma primary TKAs between 04/2010 and 09/2015. PROMs (WOMAC, SF-12, VAS pain, satisfaction) were assessed pre- and postoperatively. Absolute 1yr outcomes and pre- to postoperative improvement were compared adjusting for age, sex, BMI, ASA, comorbidities, insurance status, preoperative score level and patella resurfacing.
Results: 1151 primary TKAs were included (226 Attune, 925 PFC). At baseline, Attune patients were significantly younger, more often obese, had more comorbidities, more pain and worse function. 1yr questionnaire responsiveness was 68.2% (142 Attune, 643 PFC). WOMAC was significantly higher in the Attune group (pain 76.8 ± 22.6 vs. 71.6 ± 22.3, function 70.7 ± 25.3 vs. 68.6 ± 22.3). Unadjusted mean difference in WOMAC pain was 5.2 (95% CI: 1.1–9.3), adjusted 9.9 (95% CI: 5.2–14.6). Unadjusted mean difference in WOMAC function was 2.1 (95% CI: –2.1–6.2), adjusted 5.2 (95% CI: 0.6–9.8). Pain and function improvements were greater for Attune (WOMAC pain: 40.1 ± 22.7 vs. 31.7 ± 22.5, $p < 0.001$; VAS pain: 4.3 ± 2.6 vs 3.5 ± 2.4, $p = 0.005$; WOMAC-function: 29.4 ± 21.4 vs. 25.0 ± 21.3, $p = 0.047$).

Improvement on SF-12 was similar. 81.9% Attune patients were (very) satisfied, vs. 79.7% (p = 0.551), and 85.6% vs. 81.3% (p = 0.260), respectively, reported they would re-do the surgery.
Discussion/Conclusion: Despite baseline differences "in favor" of the PFC group, 1yr postoperative, Attune patients reported less pain, better function and greater improvement. General health improvement was similar. PROMs evaluation at longer follow-up, assessment of revision and complications rates, and reproducibility in another setting are important future steps in thorough risk-benefit assessment.

FM45

Comparison of knee orientation in a joint-centred and mechanical based coordinate system

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Background: Due to the increasing age of the western population, the number of joint replacements increase steadily. Especially total knee-joint replacements accounts as a routine intervention today. To date, the pre-operative planning is performed using knee-centered CT-datasets only. The disadvantage of these datasets is the missing account of the biomechanical axis of the lower extremity, known as "Mikulicz" line. It aligns the femoral head to the middle of the talar dome and resembles the load bearing axis in plain radiographs. For an optimal prosthesis alignment, the knee-CT-dataset must therefore be brought in congruency with this line of loading to achieve best results and eliminate rotational malalignments. In study, the aim was defined in the definition of possible relations of a knee-centered coordinate system and the mechanical axis of the leg.
Methods: CT-datasets of eleven lower extremities of humans were used (Institute of Anatomy, University of Basel). Using the visualisation and measurement software VG Studio Max, two different alignment-methods were performed. The first orientation was knee-centred in reference to specific anatomical knee-landmarks, the second alignment was chosen in relation to the mechanical axis (Mikulicz-line) of the leg. After superimposing both aligned datasets, the deviation of the knee-centred system (KCS) in regards to the biomechanical-orientated system (BOS) was measured with the centre of the knee defined as origin.
Results: Concerning the frontal plane, the KCS showed a rotation of 1.6° with its proximal extend deviating to the lateral side. In sagittal view, the KCS showed to be rotated approximately 1° frontally in its proximal extend. At last, the deviation in the transversal plane showed an outward rotation of 1.7°.
Conclusions: Pre-operative planning on knee-centred CT-datasets shows biomechanical limitations. Regarding the load-bearing axis of the patient, a rotational adaptation is necessary for the achievement of an optimal result.

FM46

Correction of posttraumatic deformities with the external fixator Taylor Spatial Frame. A review of 22 cases

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Introduction: Treatment of frequently multidimensional posttraumatic deformities is a challenge in orthopedic surgery. Full restoration of limb alignement including leg length correction is the goal of treatment. The Taylor Spatial Frame (TSF) is a software supported hexapod ring fixator, which allows for gradual and simultaneous multidimensional deformity correction, based on callusdistraction according to Ilizarovs principles. We retrospectively reviewed 22 consecutive cases of gradual, mostly multidimensional deformity corrections in the tibia and femur with the Taylor Spatial Frame regarding etiology and type of deformity, final results and complications.
Methods: We treated 15 male and 7 female patients. Average age was 29 years at the time of surgery. Deformity correction was indicated due to incomplete initial surgical treatment with subsequent persisting deformity including leg length discrepancy (n = 13), due to asymmetric premature closure of a growth plate (n = 3), postinfectious deformity (n = 1) and pseudarthrosis (n = 5). A 1-dimensional deformity (compression of pseudarthrosis) was corrected in 3 cases, a 2-dimensional deformity in 9 cases, a 3-dimensional deformity in 7 cases and a 4-dimensional deformity in 3 cases.
Results: The mean time in the external fixator was 24 weeks. All deformities could finally be corrected in full extent. Complications included temporary nerve lesion the the profound branch of the peroneal nerve after fibular osteotomy, which fully recovered after 4 months, one insufficient bone formation at the site of the callus distraction, which was treated with cancellous bone and plating and another case which needed to b treated by change of the fixator and new placement of fixation screws. Most oft he patients suffered at least once from superficial pin infections which were sufficiently treated with oral antibiotics. No deeper infections occured. At follow up (88 weeks) all patients were satisfied by the result and had no ongoing treatment related problems.
Conclusion: For multidimensional deformities such as in posttraumatic cases the TSF serves as an ideal tool to fully restore the limb alignement by simultaneous gradual correction and limb lengthening. There might be temporary disadvantages due to transfixing of the soft tissues by the fixation screws and wires, nevertheless this is a temporary problem and is equalized by the advantages of the accuracy which is provided by this method.

FM47

Does arthritis in other joints and spine influence the 1-year outcome of total hip replacement? A prospective multicenter cohort study (EUROHIP) measuring the influence of musculoskeletal morbidity

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Background: Whilst arthritis in other affected joints and back pain is known to lead to worse outcomes following total hip replacement surgery, these risk factors have not previously been operationalized as a musculoskeletal morbidity profile. The aim of this study was to measure the influence of other joints and spine (in four musculoskeletal morbidity grades) on the 1-year outcome of primary hip replacement.
Methods: The European Collaborative Database of Cost and Practice Patterns of Total Hip Replacement study (EUROHIP) consists of 1,327 patients receiving primary THR for osteoarthritis (OA) across 20 European orthopedic centers. The primary outcome was whether or not a patient responded to THR at 12-months as measured by the relative effect per patient (REPP score), calculated for each patient using the total WOMAC score. The primary predictor of interest was the grade of musculoskeletal morbidity (MSM). The cohort was grouped into four combinations of arthritis based on the index joint, other large joints and spine respectively: MSM grade 1 (single-joint), 2 (multi-joints), 3 (single-joint and spine), 4 (multi-joints and spine) (table 1). Confounders adjusted for were: age, sex, body mass index, living alone, years of hip pain, ASA grade, anxiety/depression, pre-operative WOMAC subscales.
Results: 845 patients were included for this analysis with complete 12-month follow-up WOMAC scores. The mean age was 65.7 years and 55.2% were female. Increasing MSM grade was associated with worse outcomes of surgery, where the responder rates for THR were: 254 (92.4%) MSM grade 1, 272 (87.2%) MSM grade 2, 46 (80.7%) MSM grade 3, 142 (74.4%) MSM grade 4. This was confirmed in adjusted logistic regression models: MSM grade 4 vs. 1 odds ratio (OR) 0.26 95% confidence interval (CI) (0.14, 0.46); MSM grade 3 vs. 1 OR 0.32 95%CI (0.14, 0.73); MSM grade 2 vs. 1 OR 0.56 95%CI (0.32, 1.00) (fig. 1).
Conclusions: Other joints and spine measured as musculoskeletal morbidity have a strong influence on the 1-year outcome after THR. The effect size was large in comparison to other risk factors. Even so, the majority of patients in MSM grade 4 can still profit from surgery (>75% responder rate).

Table 1
Description of Musculoskeletal morbidity (MSM) grades.

	Without Spine	With Spine
Index Joint	Grade 1	Grade 3
Index & Other large joints	416 (32.1%)	112 (8.6%)
	Grade 2	Grade 4
	479 (36.9%)	291 (22.4%)

Figure 1
Forest plot describing results of multivariable logistic regression models.

***FM48**

Long-term results of revision total hip arthroplasty with a cemented femoral component

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Introduction: Uncemented revision implants gained more and more popularity in recent years and showed excellent long-term results. Cemented stem revision combined with impaction bone grafting (IBG) is a successful but technically demanding procedure, too. Data on long-term survival for cemented stem revision without additional IBG are scarce with mainly poor results. The aim of the present study is (i) to investigate the long-term outcome regarding survivorship and radiological results of a cemented straight stem in revision THA fixed according to the shape-closed concept without IBG and (ii) to compare the results with recently published data for the same stem in primary THA.
Methods: This is a retrospective, observational, single-center study based on prospectively collected data. 178 stem revisions (172 patients) revised with the Virtec straight stem between 01/1994 and 08/2008 were included. Radiologic analysis assessed bone defects preoperatively (according the Paprosky and AAOS classification), and osteolysis, debonding and subsidence at a follow up of >10 years. The cumulative incidence for re-revision was calculated using a competing risk model. Risk factors for re-revision of the stem were analyzed using an absolute risk regression model. Data were compared recently published data in primary THA using the Virtec stems(Clauss et al. 2016).
Results: The mean clinical follow-up was 9.3 (SD 5.2) years. The cumulative incidence for aseptic loosening of the stem was 5.5% (95% CI, 2.9–10.2%) at 10 years (compared to 1.4% in the primary THA group), the cumulative incidence for re-revision for any reason was 9.9% (95% CI, 6.3–15.5%). A total of 23 stems (12.9%) were re-revised. Younger age, stem offset and larger stem size were found to be risk factors for aseptic loosening of the stem. Average radiological follow-up of the unrevised stems was 12.9 years. Osteolysis was seen in 39 patients (49%), debonding was seen in 2 cases, no fracture of the cement mantle occurred.
Conclusions: Cemented straight stems fixed according to the shape-closed concept without IBG showed excellent long-term results for revision THA regarding survivorship and radiological results. Results are comparable to primary THA with the same implant.

FM49

Smoking and elevated Cobalt concentrations increase the risk of adverse local tissue reactions in patients with metal-on-metal THA

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Introduction: Smoking has been strongly related to an increased risk of revision in patients with small head metal-on-metal total hip arthroplasty (MoM THA). Cobalt ions can cause delayed hypersensitivity type IV reaction or stimulate innate immune responses – both resulting in ALTR. Thus far the ability to predict who will develop ALTR following the insertion of a MoM THA is still limited. We assess the risk of ALTR diagnosed intraoperatively at time of revision as a function of presence/absence of two potential risk factors: smoking status (never- vs. ever-smoker) and Cobalt blood level (low vs. elevated).
Methods: We included all patients with primary MoM THAs operated 1999–2010 (same cup design, 28 mm head), who had undergone blood cobalt measurement between 5–15yrs after surgery. Cobalt concentrations >= 2 μg/l were considered elevated according to EU recommendation for lowest potential threshold. Smoking status was abstracted from anesthesiology report. ALTR was determined based on intraoperative findings and/or histology at revision.
Results: 288 MoM THAs were included (mean age 61yrs., 53% men). Of those, 134 (46.5%) were ever- and 154 never-smokers. Ever-smokers (vs. never) were younger (59 vs. 62yrs), more likely men (67% vs. 41%), with more secondary OA (35% vs. 23%) and uncemented stems (44% vs. 27%). Groups did not differ for proportion of bilateral MoM THA. Cobalt levels were elevated (>= 2 μg/l) in 72 THAs (25%), more often in never- vs. ever-smokers (32.5% vs. 16.4%). Overall, 37 of the 288 THAs (12.8%) were revised (9 never-, 28 ever-smokers) on average at 8.5yrs. ALTR was recorded in 27 of the 37 cases (9.4%). Stratification for smoking status and Cobalt revealed that among those with low levels (<2 μg/l) risk of ALTR was 1% in never-smokers (1/104) and 15.2% in ever-smokers (17/112), whereas in those with elevated levels risk was 8% (4/50) and 22.7% (5/22). Ever-smoking increased risk of ALTR at revision by 14.2% (95%CI 7.3-21.1) in those with low and by 14.7% (95%CI -4.3–33.8) in those with elevated Cobalt. Presence of Cobalt >=2 μg/l increased risk by 7% (95%CI 0.7–14.8) in never-smokers and by 7.5% (95%CI-11.2–26.3) in ever-smokers.
Conclusion: After small head MoM THA baseline risk for ALTR at revision was 1% in the absence of both risk factors. Ever-smoking increased the risk by 14%, Cobalt >=2μg/l by 7%, and presence of both by 21%, suggesting an additive effect. These findings have important implications for follow-up recommendations.

FM50

Biological response of human myogenic precursor cells to cobalt and chromium ions generated after metal on metal hip replacement

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Introduction: Metal-on-metal hip replacements are associated with adverse local tissue reaction (ALTR) and adverse reactions to metal debris (ARMD). Cobalt (Co) and Chromium (Cr) ions are important inflammatory inducers. Tissues surrounding the implant such as skeletal muscles are also infiltrated by immune cells, which trigger an important inflammatory response. In the present study, we developed an in vitro assay to examine the complex interaction between Co and Cr ions with human myogenic precursor cells (MPCs) and human monocytes. We examined the biological response of human MPCs to Co/Cr ions and/or monocytes, in particular, cell proliferation, cell differentiation, and expression of adhesion molecules including ICAM-1, known for its major role in inflammatory process.
Methods: All methods related to the human study were approved by the Commission Cantonale d'Ethique de la Recherche from the Geneva Cantonal Authorities. Freshly isolated human MPCs amplified in growth medium (GM) containing, or not, Co and/or Cr ions at 250 μM, were analyzed for their proliferative and differentiation capacities. Human MPCs were also analyzed by flow cytometry for the expression (median fluorescence intensity ratios (MFIR)) of ICAM-1 and HLA-DR (MHC class II) after 48h in the presence or not of Co and/or Cr and human monocytes.
Results: MPCs proliferation and differentiation was significantly reduced in the presence of Co ions alone and of Co/Cr ions. Cr ions alone had no significant effect on human MPCs proliferation or MPCs differentiation.
In resting conditions, human MPCs expressed low level of ICAM-1 and were negative for HLA-DR. After exposure to Co or to Co/Cr ions for 48h, human MPCs upregulated ICAM-1 (MFIR: 1.45, p <0.05 and MFIR: 1.65, p <0.05, respectively). Cr alone had no significant effect on ICAM-1 expression (MFIR: 0.9). After incubation with monocytes, human MPCs upregulated ICAM-1 expression (MFIR: 7.9, p <0.05). The presence of Co or Co/Cr together with monocytes, further enhanced ICAM-1 expression (MFIR: 45.5, p <0.05, MFIR: 43.1, p <0.05, respectively). In all the conditions described above, human MPCs did not upregulate significantly HLA-DR molecules.
Conclusions: We have developed an in vitro model that recapitulates, at least partially, the skeletal muscle inflammation surrounding the implant. The findings of this study may contribute to a better understanding of possible risk factors with regard to CoCr implant materials.

FM51

High Head-Shaft-Offset is a risk factor for early aseptic loosening in non-cemented stems

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Introduction: Early thigh pain due to aseptic stem loosening after total hip replacement is disappointing for patients and surgeons. Risk factors as BMI, male gender and young age have been described. Component associated risk factors still remain unclear. We hypothesized that greater offset by the use of lateralized femoral stems and/or L/XL-heads might be associated with a higher risk for early aseptic loosening.
Methods: We identified retrospectively all patients suffering from early thigh pain leading to aseptic stem revision at our institution between 2004 and 2016. BMI, gender, age, nicotine consumption and NSAR

medication were recorded. Femoral morphology was categorized according to Dorr on preoparative X-rays. Type and design of stems and femoral head components were recorded. High head-shaft-Offset was defined as either lateralized stem design and/or standard stem design with L or XL femoral component. The control group consisted of every uncomplicated non-cemented primary total hip replacement between 2004 and 2016.
Results: A total of 3286 primary non-cemented total hip replacements (3240 patients) with 5 stem designs were identified. In 16 patients (17 stems, 0.5%) thigh pain occurred a mean of 11 months (2–48) after implantation. They got revised a mean of 42 months (range 5-84) after index surgery. More men were affected (11/17, 64%) with a mean age of 60 years (45–83) and BMI of 29 (25-35). One patient was a smoker (0.5%), 3 (17%) took NSAR daily. Dorr Type A was most frequent (11/17, 64%), followed by B (6/11, 36%). High head-shaft Offset was found in 15 (82%) revised hips. The control group consisted of 51.2% men (1658/3240), with a mean age of 63 (15–93) years and BMI of 25 (15–63). Dorr Type A was more frequent (65%), than B (34%) and C (1%). High head-shaft Offset was present in 1840/3286 cases (56%). 9% were smokers, 26% took NSAR daily. In terms of age ($p = 0.122$), BMI ($p = 0,100$), gender ($p = 0,706$) or smoking ($p = 0,717$) no significant difference was found. High head-shaft offset was significantly more frequent in case of early loosening ($p = 0.028$) with no significant difference regarding stem design.
Conclusion: Early aseptic loosening occurs with an incidence of 0.5% in uncemented hip arthroplasty. High head-shaft-offset is an independent risk factor irrespective of stem design. Medialisation of the center of rotation during total hip replacement with preservation of the global offset leads to higher head-shaft offset and has to be reconsidered.

FM52

Discrepancies between preoperative digital planning and intraoperative measurements – is preoperative digital planning for hip replacement reliable?

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Introduction: Preoperative planning of total hip replacement (THR) is important to assess the anatomical particularities of the joint, to get distances for intraoperative measurements and is required for legal reasons. Performing a direct anterior approach the distance from the lesser trochanter to the edge of the cone is an important measurement. In daily practice we found discrepancies between preoperative digital planning and intraoperatively measured distances.
Objectives: To analyze measurement accuracy of digital preoperative planning used for total hip replacement. A single institution study.
Methods: Based on the known size of the implanted femoral head we calculated "backwards" the diameter of the reference ball. We compared this value with the known diameter of the reference ball. We included consecutive patients undergoing unilateral THR for coxarthrosis. Surgeries were performed by two orthopedic surgeons using a direct anterior approach with an extension table (Rotex; Fa. Condor©) and cementless implants (Vitamys cup, Optimys stem; Fa. Mathys©). All patients had supine X-rays (Agfa, Impax PACS©) preoperatively with a reference ball (25 mm diameter) in between the thighs. All measurements were taken with digital planning (mediCAD; Fa.Hectec©).
Hypothesis: Distances in digital planning are 100% reliable.
Results: 58 patients between March 2015 and June 2016, 50% female, mean age 71.2 years (31.3 vs 90.6). All had preoperative planning X-rays. 56 patients were included in the study. Two were excluded (1 with already contralateral THR and 1 with bilateral THR). The recalculation of the reference ball (effectively 25 mm) produced values between 23 mm and 30 mm. An assumed measurement accuracy of 100% resulted in 23% correct planning, with an accuracy of 96% in 60%, with 92% in 87%, with 88% in 96% and with 84% in 98% of all planning.
Conclusion: The hypothesis was refuted. With an assumed measurement accuracy of 92% the diameter of the reference ball matched the effective size in 87% of cases. With this measurement accuracy the distance between lesser trochanter to the edge of the cone results in a variance of 4mm. In 13% of our cases (every 7th patient) the measurement accuracy was even lower than 92%. We assume that the variable positioning of the reference ball is the main cause of the measurement inaccuracies. In order to achieve the highest precision for THR we use image intensifier intraoperatively.

FM53

Patterns of bone tracer uptake on SPECT-CT in symptomatic and asymptomatic patients with primary total hip arthroplasty

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Introduction: The primary purpose of this study was to compare BTU on SPECT/CT in symptomatic and asymptomatic THA and identify a possible relationship between BTU patterns and patient`s symptoms. The secondary purpose was to investigate if different THA designs and fixation methods (cemented versus uncemented) lead to different BTU patterns.
Methods: A total of 58 THAs, 31 symptomatic (group S) and 27 asymptomatic (group AS), were prospectively collected and retrospectively analysed. All symptomatic patients underwent standardised detailed history, clinical examination, radiographs and 99mTc-HDP SPECT/CT. Bone tracer uptake (BTU) in SPECT/CT was quantified in three dimensions and anatomically localized in a scheme of quadrants and levels using a customized previously validated software. T test was used on both quadrants and levels inside and between groups. A Pearson correlation was performed for BTU within the quadrants. An area under receiver operating characteristic curves was drawn in order to find a BTU value that could differentiate the two groups. Within the groups, patients with cemented and uncemented stems were compared for influences on BTU intensity.
Results: The causes of pain were identified in 61% of the patients. The most common problem was aseptic loosening (n = 11). In group AS, levels 1, 2 and 5 had similar BTUs. BTUs in these levels were significantly higher than in level 3, 4 and 6. In group S no significant differences were seen in terms of BTU in level 1–5. However, BTU here was significantly higher than at level 6 ($p < 0.001$). In both groups, level 1 the superior had a significantly higher BTU than level 2 (group AS $p < 0.01$, group S $p < 0.05$). Comparing the BTU of the two groups among levels, significant differences were found for level 4, level 5 and the entire stem areas ($p < 0.05$). The ROC curve calculated on the whole stem allowed to identify a BTU ratio of 3.1 that separated the 92.6% patients of group AS with BTU<3.1 from the 54.8% of patients of group S with a BTU≥3.1. With regards to the fixation technique, only the BTU at the level 6 in group S presented a significant difference between cemented and uncemented stems ($p < 0.05$).
Conclusions: Higher BTU levels significantly correlated with symptoms, but a normal BTU could not exclude a specific pathology after THA. A threshold of BTU in SPECT/CT was identified to distinguish between symptomatic and asymptomatic patients after THA.

FM54

Five-year results of a cementless AMIStem-H® femoral component in primary total hip arthroplasty

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Introduction: The aims of this analysis were (1) to compare the presence of radiolucency at five-year follow-up with the one-year follow-up, (2) to evaluate if radiolucency signs are correlated with clinical aspects (discomfort or pain), anatomical shape of the femur, patient characteristics (age, gender, BMI and activity level) and implant characteristics (type and size), and (3) to determine the cumulative five-year survivorship of the implant after total hip arthroplasty (THA).
Methods: A total of 269 patients (290 hips) who underwent cementless THA by four surgeons with the AMIStem-H® cementless stem (Medacta International SA, Castel San Pietro, Switzerland) between December 2009 and January 2012 were evaluated at five-year follow-up. Radiolucency lines presence has been measured according to Gruen zone classification. The results were compared with the corresponding one-year follow-up. Anatomical shape of the femur has been classified by using Dorr classification. Hip pain has been measured by a surgeon using a six point Likert scale. The level of activity has been classified in a five point Likert scale.
Results: A five-year follow-up was available for 205 patients (226 hips). Radiolucency signs between the one- and five-year follow-up changed particularly in the proximal part of the stem (Gruen zones 1, 7, 8 and 14). In the Gruen zones 1, 7 and 14 the percentage of patients with radiolucencies increased about 10–15%. The Gruen zone 8 percentage of patients dropped about 7%. Apart from that, the frequencies of radiolucency signs remained almost unchanged. No correlation between radiolucency presence and clinical aspects

has been determined. A total of 32 patients (14.2%) had at least a radiolucency of higher than 2 mm in one Gruen zone, thereof only 5 (2.2%) were symptomatic (3 slight, 1 moderate and 1 marked pain). Six patients required a femoral revision (four aseptic loosening, one due to fracture and one due to infection). Consequently, the cumulative five-year survivorship of the stem was 97.60% (95% CI: 95.60% to 99.60%).
Conclusions: No correlation between the measured variables and the presence of radiolucencies has been detected. The survivorship of 97.60% shows a good survival rate which is comparable to the annual report of National Joint Registry for England and Wales of 2015 for uncemented ceramic-on-polyethylene (CoP) devices (97.88%).

FM55

The impact of femoral offset changes on contact patch to rim distance in total hip arthroplasty

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Background: The contact patch is defined as the intersection point of the joint reaction force vector and the cup. Its distance to the rim of the cup is called the contact patch to rim distance (CPR) and is related to edge loading and therefore an important parameter determining the longevity of THR. The direction of the force vector is affected by hip motion. We assume that inaccurate reconstruction of femoral offset affects the direction of the vector an hence CPR.
Aim: To calculate CPR and joint forces during the stance phase of a gait cycle in THR with an anatomic reconstruction, and with a loss or gain of femoral offset.
Methods: Finite element model of the hip were built based on CT scans of 15 patients undergoing THR. These models were integrated in a generic musculoskeletal model of the lower extremities (OPEN SIM) to simulate muscle and joint forces during normal gait. Virtual THR were implanted in each model with a cup inclination of 42° and anterversion of 15° and a 32 mm prosthetic head. The reconstruction was performed either anatomical, or with a loss or gain of 20% of the femoral offset. Gait was then simulated over 11 cycles and the direction and magnitude of the joint reaction force was extracted. Finally, CPR was calculated.
Results: The contact patch follows a complex path during gait, but is mostly moving in the anterior-superior quadrant of the cup. Changes in femoral offset had only minimal impact on CPR. Minimal CPR was 10.2 ± 0.7 mm (range 8.2–11.4 mm) if the reconstruction was anatomical. If the offset was increased or decreased by 20% minimal CPR was 11.1 ± 0.8 mm (range 9.2–12.6 mm) and 8.9 ± 0.9 mm (range 7.4–10.2 mm), respectively. CPR at the maximal force was 11.3 ± 1.6 mm (range 8.7–16.2 mm) in anatomical reconstrucions and 11.7 ± 1.5 mm (range 9.7–16.5 mm) and 12.1 ± 2.4 mm (range 8.7–15.8 mm) in reconstruction with a gain of loss of femoral offset.
Conclusion: CPR varies considerably during gait while the contact patch remains mostly in the anterior-superior quadrant of the cup. Changes in femoral offset of up to 20% have little effect on CPR and edge loading.

FM56

Impact of a collar on primary stability of uncemented stems: an in vitro analysis of micromotion between bone and implant

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Purpose: The aim of this study is to quantitatively compare the difference in primary stability between collarless and collared versions of the same femoral stem. Specifically, we tested differences in subsidence and micromotion.
Methods: Collarless and collared versions of the same cementless femoral stem were implanted in two groups of six fresh-frozen cadaveric femurs. Each implanted femur was then subsequently tested for axial compressive and torsional loadings. A micro-CT based technique was applied to quantify implant subsidence and compute the map of local micromotion around the femoral stems. Micromotion of collarless and collared stems was compared in each Gruen zone.
Results: Subsidence was higher but not significantly with collarless (41.0 ± 29.9 µm) than with collared stems (37.0 ± 44.6 µm). In compression, micromotion was lower with collarless (19.5 ± 5 µm) than with collared stems (43.3 ± 33.1 µm). In torsion, micromotion was also lower with collarless (96.9 ± 59.8 µm) than collared stems (118.7 ± 45.0 µm). Micromotion was only significantly lower ($p = 0.001$) in Gruen zone 1 and for compression with collarless (7.0 ± 0.6 µm) than with collared stems (22.6 ± 25.5 µm).
Conclusions: There was a good primary stability for both stem designs, with a mean micromotion below the osseointegration threshold. The collar had no influence on subsidence or micromotion, with good press-fit and under loading conditions similar to those observed in normal daily activity. Further studies are required to test the potential advantage of collar with higher loads, undersized stems, or osteoporotic femurs .

***FM57**

Anterior internal fixation of the pelvic ring with a rod-screw-system – what rod-to-bone distance is anatomically optimal?

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Introduction: Anterior fixation of the pelvis using subcutaneous supra-acetabular pedicle screw internal fixation (INFIX) has proven to be a useful tool for pelvic fixation in patients where open fixation is not suited. The purpose of this study was to find a rod-to-bone distance for the INFIX that allows for minimal hazard to the inguinal neuro-vascular structures and as little as possible interference with the soft tissues of the proximal thigh when the patient is sitting.
Methods: An INFIX was applied to the pelvises of 10 soft-embalmed cadavers with three different rod-to-bone distances at the level of the supra-acetabular pedicle screw. With each configuration, the relation of the rod to the neuro-vascular and the muscular surroundings was described and measured in supine and sitting position of the cadaver. In addition, the changes in compartmental pressure inside the muscular and the vascular lacunae were assessed using a manometric balloon tamp.
Results: Except for the femoral artery, vein and nerve, all investigated anatomical structures of the groin were under compression (distance to the rod <3 mm) with a rod-to-bone distance of 1 cm (fig. 1). With a rod-to-bone distance of 2 cm most of the anatomical structures were safe in supine position, although less than with 3 cm. With hip flexion some structures got under compression, especially the lateral femoral cutaneous nerve (LFCN, 80%) and the anterior femoral cutaneous nerve (AFCN, 35 %). With a rod-to-bone distance of 3 cm almost all anatomical structures were safe in supine position, while with hip flexion most superficial structures of the proximal thigh got under compression, especially the LFCN (75 %) and the AFCN (60%). When sitting, the sartorius muscle was compressed in >90% of the samples with all three configurations, with a rod-to-bone distance of 1 cm this was also the case in supine position. In both the Lacuna vasorum and the Lacuna musculorum, there was a significantly greater increase of intracompartemental balloon pressure when sitting up with an INFIX applied in 1 cm rod-to-bone distance when compared to the configurations with 2 or 3 cm (ANOVA, $p < 0.05$).
Conclusion: Aiming for a rod-to-bone distance of 2 cm is the safest way with regard to compression of the femoral neuro-vascular bundle and at the same time leads to the least compression of more superficial structures like the LFCN, the AFCN, or the sartorius muscle in sitting position.

FM58

Limb lengthening with the Precice magnetic driven nail

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Introduction: Several fully implanted nail systems are available for bone lengthening. From our experience the magnetic driven Precice nail (Ellipse technology) is superior to those we used before. Lengthening of the precice nail is activated by a portable remote externally applied magnet.
Methods: Insertion of the nail principally follows standards used for intramedullary nail fixation of fractures after prereaming to a diameter 2 mm larger than the nail used. Before insertion of the nail, drill holes at the predetermined level are made for “ventilation” during reaming and as breaking points of the corticotomy. Lengthening follows the standards of Codivilla/Ilizarov (1 mm per day after a waiting period of 7 to 10 days). Partial weight bearing was allowed until consolidation appeared sufficient. 1. Male patient (37): Following femur fracture

healed with 2 cm shortening the patient felt significant discomfort, when barefoot or walking without shoe lift. This was solved after uncomplicated lengthening over the precice nail. 2. Male patient (26): At age 6 years open femur/knee trauma. At age 28 years leg shortening and flexion contracture of the knee of 45° with extensive soft tissue scarring – which did not allow him to use his leg for weight bearing. Following knee arthrodesis, femur lengthening of 14 cm was performed. This needed the exchange of the nail due to the maximal telescoping of 8 cm. 3. Male patient (23): At one year of age with Meningococcemia he developed a Waterhouse-Friderichsen syndrome affecting both legs. During childhood he had 4 lengthenings of the tibia and femur using external fixators. At present his problem was sitting in the auditory as the orthoprosthesis needed to compensate for the deformity of the lower leg and 8cm shortness of the femur. Lenghtening with the precice nail allowed to equalize femur length and thus shortening the orthoprosthesis which enabled him to sit comfortably and continue to attend the University.
Results: In the presented patients lengthening of 2 cm to 14 cm with complete bone healing was achieved without complications. Full weight bearing was possible three months after completion of lengthening.
Conclusion: At present the Precice nail appears to be the most advanced lengthening nail technique. As it allows also shortening it can be applied for compression of segmental resections and later reconstruction by callus distraction. We look forward to the development of a nail allowing also closed segment transport.

***FM59**

Stability in SER II-IV ankle fractures and weightbering radiographs

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SER lateral malleolar fractures are common. The assessment of the stability of the ankle fracture is crucial for decision making of treatment which is associated with the integrity of the deltoid ligament (SERII-III). Slight talar shift can lead to extensive decrease of tibio-talar contact area (Ramsey 1999). Several clinical tests have been proposed of which static weightbearing radiography is used to measure the lateral talar shift with the medial clear space to detect medial instability (SERIV). However, the correlation of a stable ankle joint under weightbearing load with the structural integrity of the deltoid ligament has not been shown yet which we want to investigate. 17 patients with lateral malleolar fractures were investigated who underwent an MRI and weightbearing radiography examination. In the MRI, the deep deltoid ligament was assessed as intact, partial und complete rupture. The medial clear space was measured – distance between the lateral border of the medial malleolus and the medial border of the talus at the level of the talar dome (millimeter). 7 patients suffered from deep deltoid ligament rupture (4 partial; 3 complete).The medial clear space in patients with intact deep deltoid ligament was 2.96 + 0.41 mm in mean, in partial rupture 2.8 + 0.38 mm, in complete rupture 3.43 + 0.23 mm. When counting the complete and partial ruptures together the mean was 3.07 + 0.45 mm and in partial ruptures plus the intact ones 2.91 + 0.40 mm. Our results show no significant correlation between the medial clear space and the integrity of the deep deltoid ligament. A negative weightbearing radiograph does not exclude deep deltoid ligament rupture. This fact might indicate the importance of the intrinsic stability provided by the osseous contour of the highly congruent ankle joint. In our opinion, malleolar fracture with deep deltoid ligament rupture (SERIV) can therefore be treated conservatively as long as ankle stability is provided under physiological load.

FM60

Weightbearing radiographs versus gravity stress radiographs for stability evaluation of supination-external rotation fractures of the ankle

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Background: Isolated lateral malleolar fractures may result from a supination-external rotation (SER) injury of the ankle. Stable fractures maintain tibiotalar congruence due to competent medial restraints including the deltoid ligament. They can be treated nonoperatively with excellent functional results and long-term prognosis. Unstable fractures include a deltoid ligament rupture and are assumed to benefit from operative treatment. Stability can be assessed with either stress radiographs or weightbearing radiographs.
Objectives: The goal of this study was to compare these radiographs to predict functional outcome.
Study Design & Methods: A consecutive series of patients with closed isolated lateral malleolar fractures (presumed AO 44-B1, Lauge-Hansen SER type) were prospectively enrolled from September 2008 to August 2015. Patients with clearly unstable fractures (medial clear space >7 mm) on the initial nonweightbearing radiograph were excluded and operated. All other patients were examined with a weightbearing anteroposterior radiograph of the ankle 3 to 7 days after trauma. A stable fracture was defined as a medial clear space of <4 mm. Borderline instability of the fracture was assumed when the medial clear space was 4–7 mm. If a fracture was unstable in both radiographs operative fixation was advised. All non-operatively treated patients were seen for clinical and radiographic follow-up 1 to 2 years after trauma
Results: Out of 104 patients with isolated lateral malleolar fractures of the SER type, 14 patients were treated operatively because of clear instability, 44 demonstrated instability on the gravity stress but stability on the weightbearing radiograph (g-unstable), 46 were stable on both radiographs (g-stable). All were treated nonoperatively. At average follow-up of 20 months no significant differences were seen in the AOFAS hindfoot score (92 points g-stable group vs 93 points g-instable group), the FFI score (11 vs 10 points), the SF-36 physical component (86 vs 85 points) and SF-36 mental component (84 vs 81 points). Radiographically all fractures had healed with anatomic congruity of the ankle.
Conclusions: Weightbearing radiographs provide a reliable basis to decide about stability and nonoperative treatment in isolated lateral malleolar fractures of the SER type with excellent clinical and radiographic outcome at short-term follow-up. Gravity stress radiographs appear to overrate the need for operative treatment.

***FM61**

The sinus tarsi approach: a minimal invasive procedure to treat comminuted calcaneal fractures

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Background: Complication rates following treatment of intra-articular displaced calcaneal fractures are up to 33%. Although the lateral extended L-shaped approach allows for good exposition of the corpus fragments, visualisation of the subtalar joint is often insufficient and/or associated with large fascio-cutaneous flaps. Additionally, complications such as soft tissue necrosis, wound infections, and bone necrosis due to lateral devascularisation frequently occur. A less invasive alternative, the sinus tarsi approach with indirect reduction over a tibio-calcaneal distractor, is a reliable method that may result in less soft tissue complications.
Materials: Between October 2013 and October 2016, 16 displaced calcaneal fractures (one bilateral) were treated at our institution. Fourteen cases were treated using the sinus tarsi approach with tibio-calcaneal distraction. Clinical and radiological follow-up visits (6, 12, and 36 weeks) included assessments with the American Orthopaedics Foot and Ankle Society (AOFAS) scale and the modified ROWE-Score.
Results: Anatomical reduction of the subtalar joint and restoration of Bohler's angle could be achieved in all fracture types and 93% of the cases. No skin necrosis occurred; however, one wound infection needed revision. The median operation time was 60 minutes (IQR 50-60, range 25–95). At the 9 month follow up visit, outcome scores were favourable with a mean AOFS of 85 (±10.5) and a modified Rowe Score of 86 (±12).
Conclusions: The sinus tarsi approach for displaced intra-articular calcaneal fractures resulted in anatomical restoration of the calcaneus in 93% of the cases. Operation time was short, complication rates were low, and clinical outcomes were favourable.
Key words: Sinus tarsi approach, calcaneal fractures, minimal invasive

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FM62

The V sign in lateral talar process fractures: an experimental study using a foot and ankle model

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Background: Lateral talar process fractures (LTPF) constitute 15% of ankle injuries in snowboarders. They are often misdiagnosed on conventional radiographs, which are also susceptible to rotational

malpositioning due to pain. A positive V sign is an interruption of the contour of the lateral talar process. It has been suggested to be pathognomonic for LTPF. However, there are very few studies about this topic. The objectives were to study whether the V sign is useful in diagnosing LTPF.
Methods: In an experimental study, two investigators evaluated lateral radiographs (n = 108) of high resolution, solid foam, radiopaque distal foot and ankle models. Two other investigators, who obtained the radiographs, defined the gold standard. Four different models (no fracture, type A, B, or C fractures according to Hawkins) and three varying ankle joint positions (0°, 20°, and 40° of inversion, plantar flexion, and internal rotation) were independent variables. The correct detection of a V sign on lateral radiographs was the primary dependent variable and the detection of the fracture type and uncertainty in making this decision were the secondary dependent variables. The chosen study size surpassed the sample size calculation. The chi-squared test was used for categorical data.
Results: There were fair interobserver agreements on the V sign and fracture types (kappa coefficient [κ] = 0.35, 95% confidence interval [CI] 0.18–0.53, p <0.001 and κ = 0.37, 95% CI 0.26–0.48, p <0.001). For the detection of the V sign, the mean sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratio, and mean uncertainty were 77% (95% CI 67–86%), 59% (95% CI 39–78%), 85% (95% CI 75–92%), 46% (95% CI 29–63%), 2, and 38%. Increased inversion and type B fractures were associated with better detection of the V sign (p = 0.035 and p = 0.011 as well as p = 0.001 and p = 0.013, for each investigator). Plantar flexion and internal rotation were not associated with the V sign (p = 0.31 and 0.33 as well as 0.35 and 0.53, for each investigator).
Conclusion: It is not recommended to exclusively use the V sign for the evaluation of LTPF. If negative, LTPF cannot be excluded. However, if positive, it may be a helpful surrogate parameter for the presence of LTPF, especially type B fractures. Inversion may lead to better visualization of the V sign. This knowledge about the V sign is a valuable asset to the diagnostic skillset of physicians.

Das Abstract FM63 wurde zurückgezogen.

FM64

Return to sport after a standardized nonoperative early weightbearing protocol for acute achilles tendon rupture

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Introduction: In young and active patients with acute Achilles tendon rupture, return to previous sports activity level after treatment with standardized nonoperative immediate full weight-bearing protocol is unknown. In a consecutive series of patients the sports activity level, functional outcome, and complication rate was assessed.
Methods: A total of 171 patients were consecutively treated with a combination of an equinus cast and rehabilitation boot, which enables immediate full weight-bearing and early functional rehabilitation. 114 patients were available for clinical followup and completed questionnaires to calculate Activity Rating Scale Score (ARS), and Tegner Activity Scale Score. These scores were compared before the rupture and at 5-year followup. Based on the Tegner Activity Scale Score before the rupture, patients were divided into a low-level activity (<5) and high-level activity (>5) group and return to sports activity was compared. Clinical assessment at minimum 12-months followup (mean, 27 ± 20 months; range 12–88) included testing of plantar flexion strength and endurance, calf circumference, tendon length, and subjective parameters to calculate a modified Thermann score.
Results: Overall no significant change in the mean Tegner activity scale score (6 ± 1 before the rupture and 5 ± 1 after 5 years; p = 0.124) and in mean ARS score (2.3 ± 0.7 before the rupture and 2 ± 0.6 after 5 years; p = 0.44) was noted. 70% of patients in the high-level activity group returned to the previous Tegner Activity Scale Score at the 5-year followup compared to 92% of the patients in the low-level activity group (p = 0.013); to previous ARS Score 82% and 92% of the patients (p = 0.115). The mean Thermann score was 82 ± 13 (range, 41–100). There were 9.3% reruptures (8 with and 3 without an adequate trauma), 5 deep venous thromboses, 1 complex regional pain syndrome.
Conclusion: Most patients return to their previous sports activity level after a standardized nonoperative early full-weightbearing treatment protocol for acute Achilles tendon rupture at mid-term followup and show favorable functional short-term outcome. Even in high-level active patients return to sports level activity was achieved in the majority of cases. Rerupture rate is comparable to current literature for nonoperative treatment, even with immediate weight bearing.

FM65

Reversed L-shaped osteotomy for hallux valgus: do the number of screws for fixation, body mass index, or additional surgical procedures matter?

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Background: Hallux valgus deformity (HV) affects around every fourth person. Its surgical treatment is a flagship of orthopaedic surgery, but the best surgical technique and reasons for unsatisfactory outcomes remain controversial. The aim of this study was to investigate associations between potential risk factors and outcomes after reversed L-shaped osteotomy (ReveL) for HV.
Methods: A retrospective single-center cohort study was conducted between 2004–2013. It included patients ≥18 years with ReveL for HV and applied strict exclusion criteria. The exposure variables were (1) number of screws used for fixation of the osteotomy, (2) BMI, and (3) additional surgical procedures for HV; e.g. Akin osteotomy. The primary outcome was radiological recurrence of HV (increased HV angle [HVA] >15 degrees) at last follow-up. Secondary outcomes were limited patient satisfaction, complication, and revision. Logistic regression adjusted for confounders; a priori for age, sex, and preoperative HVA.
Results: The median follow-up was 12.0 (interquartile range = 4.0–19.0) months (n = 827). There were 203 (25%) recurrences, 124 (15.3%) limited satisfactions, 37 (4.6%) complications, and 20 (2.5%) revisions. No associations between (1) the number of screws or (2) BMI and recurrence were found; independent of age, sex, additional surgical procedure for HV, and preoperative HVA (odds ratio [OR] = 0.63 [95% confidence interval = 0.35–1.12], p = 0.12 and OR = 1.16 [0.74–1.83], p = 0.51). (3) An additional surgical procedure for HV, male sex, and increased preoperative HVA were more likely to have recurrence (OR = 2.07 [1.00–4.29], p = 0.050, OR = 2.03 [1.29–3.22],

p = 0.002, and OR = 4.49 [1.05–19.12], p = 0.042). Males were also more likely to have limited patient satisfaction (OR = 1.81 [1.06–3.10], p = 0.031). Concomitant diseases and bilateral surgery were associated with more revisions (OR = 13.14 [1.64–105.20], p = 0.015 and OR = 3.29 [1.12–9.64], p = 0.030).
Conclusions: This large cohort of ReveL osteotomies for HV indicates that (1) one screw may be used for fixation to reduce costs and (2) non-obese and obese patients have similar outcomes. The risk of unfavourable outcomes is higher in (3) additional surgical procedures for HV, males, larger deformities, concomitant diseases, and bilateral surgeries. Overall, ReveL is a good surgical option due to acceptable rates of recurrence and limited satisfaction, as well as low rates of complications and revisions.

FM66

Free vascularised corticoperiosteal medial femoral condyle flap for ankle and middle foot reconstruction. Efficacy and donor site morbidity

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Background: Avascular necrosis (AVN) or recalcitrant non-union in lower extremity occurs in situations of poor vascular supply of the fracture or arthrodesis site. In these cases the use of a conventional bone graft is often insufficient and osteogenetic enhancement is required. The free corticoperiosteal medial femoral condyle (MFC) flap has been extensively used to treat persistent non-unions in the upper extremity. Few published studies have reported its use for complex reconstruction of ankle and foot and a very high rate of healing with minimal donor site morbidity has been achieved. We have chosen this flap for cases of ankle and midfoot recalcitrant non-union, where reconstruction with a conventional bone graft had already failed. Our aim was to provide a safe and definitive bone healing solution, opting for a low donor site morbidity, in comparison with the alternatives of vascularized iliac or fibula graft.
Objectives: To evaluate the efficacy and the morbidity of this technique and to assess the donor site morbidity, clinically and radiologically.
Study design and methods: We reviewed retrospectively all the cases of recalcitrant non-union in the ankle or midfoot treated with free MFC flap from January 2010 to December 2015. Indications were previous failed subtalar, talonavicular or tibiotalar arthrodesis, persistent distal tibia defect and talus AVN. We studied the union rate, time to union and time to full weight bearing. We also invited the participants for clinical and radiological assessment of the reconstructed area and the donor site and we asked them to fill out the Foot Function Index questionnaire.
Results: Our mean follow up was 3 years (15–74 months) and we included 12 patients. The mean number of previous operations was 3,3. Complete union was achieved in 10 out of 12 cases (83%). The mean time to first signs of union was 2,1 months and to complete union 9,2 months. The mean time to full weight bearing was 3,1 months. Pain relief was achieved in 9 out of 12 cases (75%). The donor site morbidity was minimal to zero.
Conclusions: The use of free corticoperiosteal MFC flap provides a sufficient bone healing in difficult cases of recalcitrant non-union in ankle and midfoot. We recommend its use for these cases, opting for a definitive and safe solution. In comparison with other vascularized bone grafts the donor site morbidity is lower, in terms of simplicity of graft harvesting, immediate postoperative pain and activity restriction.

FM67

Distal IPJ and 1st MTPJ fusion for osteomyelitis and septic joint arthritis in diabetic foot syndrome patients

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Backround: In cases of Diabetic Foot ulcers over joints with associated septic arthritis acheving the erradication of the infection can be difficult. In order to avoid amputation or instability following a debridment , which often is associated with functional impairment , the goal of treatment is to be as preserving as possible. Therefor the backbone of our treatment in such cases consist of 3 major rules.
1. A thorough debridment of the infectious and necrotic tissue.
2. Getting a primary stabilization by fusing the joint. 3. Sufficiant soft tissue coverage to the post debribed ulcer. To our knowlage there is no experience with fixating a small joint after a debridment with a screw.
Methods: Retrospective 25 patients with IPJ or 1st MTPJ septic arthritis due to diabetic ulcers between 2013–2016. All patients had a combination of bone and soft tissue infections. All patients had a preoperative radiographs, 22 patients had a MRI scan preoperativly to define the extent of the bony and soft-tissue infection size . A thorough debridment was done that includes both soft tissue and infected bone until macroscopically there were no signs of infection. After debridment a fusion of infected joint (2.7 or 3.5 screws) was made to stabilize the joint so that the wound could heal.
Results: The preservation of the first ray by solid MTPJ or IP fusion was achieved in 21 patients (84%). 4 patients(16%) endend up with an amputation of the 1st toe or 1st ray due to ongoing infection. In 3 cases where amputation was done, the basal phalanx could be left to safe the biomechanical properties of the first ray. 3 patients (12%) with an IP-fusion had implant loosening due to ongoing osteomyelitis and insufifcient soft-tissue healing. 1 patient needed a through MTP-I head resection. In 21 patients, pathogens could be identified. In 89% Staph. aureus was found. 24 patients had relevant concomitant diseases during the 12-month follow-up, all patients achieved healed diabetic foot ulcers and could mobilize in protective orthopaedic shoes.
Conclusion: Arthrodesis of IP- or MTP-joints in diabetic foot patients with an acute septic arthritis presents a successful way of treatment in order to achieve a stable situation for soft-tissue healing.

FM68

The foot factor: fifth metatarsal bone morphology: correlation with patient height and shoe size

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Introduction: The proximal fifth metatarsal fracture is a common foot injury. The treatment of choice of zone II and III fractures is the percutaneous intramedullary single screw fixation with an appropriate but maximal large diameter for an optimized fit and compression. Therefore the dimensions of the metatarsal bone are of peculiar interest. Our belief is that there is a strong correlation between the easily measurable parameters shoe size and height of the patient to the fifth metatarsal bone morphology, which helps to perform a safe and fast preoperative planning and operation.
Methods: A sample of 50 patients with computer tomographic imaging of the foot for investigation other than fifth metatarsal pathology were recruited, 26male and 24 female. 27 patients living in Australia, 23 in Switzerland. The parameters of the fifth metatarsal bone anatomy were measured and set into correlation with shoe size and height.
Results: The shoe size ranged from 31 to 48.5 with a mean of 41.58. Average height 171.75 cm with a range from 152 cm to 198. Sagittal central length ranged from 54.8 mm to 82.1 mm with a mean of 66.5 mm. The proximal third internal parameter ranged from 3.6 to 9.1 mm with a mean of 6.6 mm. In conclusion there is a notable positive correlation between the dimensions of the fifth metatarsal, shoe size and height.
Conclusion: When preoperatively determining the optimal screw size, we believe the easily measurable parameters shoe size and height help to get a good perception of the dimensions and treatment of fifth metatarsal fractures even in the absence of a CT scan. This assessment assists to treat proximal fifth metatarsal fractures more effectively. We believe that the 5.5 mm screw may be used safely in the majority of patients with fifth metatarsal fractures, patients with a shoe size under 36 and under 154 cm height should be treated carefully.

***FM69**

Clinical outcome for total ankle replacement in patients younger than 50 years

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Intro: Total ankle replacement (TAR) has been shown to be an effective treatment in reducing pain and maintaining function in end-stage ankle osteoarthritis. Nowadays, TAR is not only proclaimed for old and inactive patients. However, especially younger patients with a great activity level have high demands and expectations towards functionality of TAR. Therefore the interest in clinical results of this subgroup has increased. The purpose of this study was to compare the clinical outcome between patients aged <50 and those aged ≥50 years.
Methods: A consecutive series of 813 primary TARs (3rd generation HINTEGRA, 446 male, 367 female) performed between May 2003 and December 2013 were divided into two groups and analyzed: patients <50 and ≥50 years at the time of implantation. Clinical outcome (AOFAS hindfoot score, pain on VAS, ROM) was documented before

implantation and at the date of the last follow-up. Additionally, patients were asked to rate their satisfaction with the outcome.
Results: At time of implantation, 129 patients (15.9%) were <50 years. In this group, primary osteoarthritis was less common and mean follow-up time was slightly longer (5.0 vs. 5.6 years). Younger patients had a lower preoperative AOFAS hindfoot score (39 vs. 44, p = 0.010) and more preoperative pain (6.7 vs. 6.1, p = 0.002). At the last follow-up younger patients had lower AOFAS score (66 vs. 71, p = 0.003) and more pain (2.6 vs. 1.9, p <0.001). Nonetheless, the improvement of the clinical outcome after implantation was highly significant and did not differ between the groups. The ROM increased in the younger group by 3° on average while in the older group it remained unchanged(p = 0.034). In total, 79% were satisfied or very satisfied with the obtained result. However, in the younger group, the rate of dissatisfied patients was higher (14.3% vs 6.5%, p = 0.011).
Conclusion: The improvement in the clinical outcome is the same in both groups although the baseline level is lower in the younger group. This finding is in contrast to other studies showing better clinical results for younger patients. In younger patients the activity level and expectations might be higher. This may explain the higher rate of dissatisfied patients in this specific patient group. Nevertheless, it seems to be justified to consider TAR in patients < 50 years, especially when considering the potential benefit of preserving overall foot function at long-term, thus preserving physiological load on the peritalar joints.

***FM70**

Revision rate of total ankle replacement in patients younger than 50 years

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Introduction: In the last decades, total ankle replacement (TAR) has become more important in the treatment of end-stage osteoarthritis. In contrast to ankle fusion, TAR preserves some motion at the ankle, protecting the peritalar joints from overload and subsequent osteoarthritis. This might be a significant advantage for younger patients, whose life expectancy at the time of surgery is long. However, younger patients tend to be more active, thus exposing their replaced joint to higher forces. This may potentially result in increased wear and revision rates. The purpose of this study was to compare the survivorship of TAR between patients <50 and those ≥50 years, and to assess potential risks leading to revision.
Methods: A consecutive series of 813 primary TARs (3rd generation HINTEGRA, 446 male, 367 female) performed between May 2003 and December 2013 were analyzed. The survivorship of the TAR of patients aged <50 years at the time of implantation were compared to patients aged ≥50 years using Kaplan-Meier. Endpoint was defined as a revision of any metallic component, e.g. the exchange of the tibial and/or talar component, or conversion to an ankle fusion. Patients without any revision were censored at the date of last contact or death.
Results: At the time of surgery, 129 patients (15.9%) were younger, and 784 (84.1%) were older than 50 years. While posttraumatic osteoarthritis was similar in both groups, primary osteoarthritis was less common in the younger group. The mean follow-up time was slightly longer in the younger group (5.0 vs. 5.6 years). Overall, a total of 81 ankles (10%) were revised. The reason for revision was: cysts/necrosis, 24 (29.6%); misalignment/instability, 20 (24.7%); aseptic loosening, 19 (23.5%); pain/impingement, 9 (11.1%); deep infection, 7 (8.6%); periprosthetic fracture, 2 (2.5%). In 62 ankles a revision of one or both components was done, in 19 cases (23.5%) the TAR was converted to an ankle fusion. Ten year Survivorship was 84.3% for patients aged < 50 and 81.6% for patients aged ≥50 at the time point of TAR (p = 0.68).
Conclusion: The risk of a revision was not higher in the younger patient cohort, despite higher stress levels. This suggests that TAR can be considered in younger patients without the fear of early revision. Finding contrasts with other replacements where the risk for revision was found to be increased with a younger age. However, a longer observation study may be necessary to support this findings at long-term.

***FM71**

Subtalar joint arthritis after total ankle replacement

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Introduction: Total ankle replacement (TAR) has been shown to be effective to reduce pain and maintain function in posttraumatic ankle arthritis. Compared to ankle fusion, TAR reproduces hindfoot kinematics more physiological; however, the suggestion that the maintenance of motion has a protective effect on the subtalar joint is still a matter of debate. Only a scarce number of long-term studies exist supporting this statement. The purpose of this study was, to evaluate the rate of ST joint fusion following TAR and to investigate if the integrity of the joints adjacent to the upper ankle can be preserved when treating patients with a TAR as opposed to ankle fusion.
Methods: A consecutive series of 1053 primary TAR (580 male, 473 female) performed between May 2000 and December 2014 were retrospectively identified. Patients who underwent a subtalar fusion following TAR were analyzed. Radiographs before implantation and before fusion were classified using the Kellgren and Lawrence Grading Score (KLS). Fusion was confirmed on conventional radiographs. The indication for surgery and time between implantation and fusion were analyzed.
Results: In 23 cases (2.2%, 10 male, 13 female) a subtalar fusion was performed. The indication for TAR was posttraumatic osteoarthritis (OA) in all but one case. The indication for fusion was progressive OA in 13 cases (57%), instability in 6 cases (26%) and cystic changes/osteonecrosis of the talus in 4 cases (17%). The median time between implantation and fusion was 2.5 (0.2–9.0) years. Median time to subtalar fusion for patients developing progressive OA was 5.2 years, for other reasons 1.8 years (p = 0.09). An increase of two stages on the subtalar KLS was observed in 6 cases and of one stage in 4 cases. In 10 cases, subtalar OA was preexisting and remained unchanged, 3 radiographs before fusion were missing. Consolidation at the subtalar joint was confirmed in 19 cases, in 3 cases no postoperative radiographs were available and in one case a nonunion was diagnosed by CT-scan after 5 months.
Conclusion: The rate of subtalar joint OA after TAR in our collective is very low and comparable to the literature. In almost half of the patients requiring fusion the grade of subtalar OA remained constant since TAR, which suggests better subtalar integrity as opposed to ankle fusion. Time to fusion tends to be shorter for reasons other than progressive OA. Fusion rates of the subtalar joint after TAR are excellent and higher than after ankle fusion.

FM72

Subtalar joint configuration in ankle osteoarthritis

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Background: The influence of the subtalar joint on the evolution of ankle joint osteoarthritis is still a matter of debate. Although subtalar joint compensation of deformities above the ankle joint was proposed until mid-stage of ankle osteoarthritis, the evidence of this assumption is weak. In this study, we investigated the subtalar joint configuration in different stages of ankle joint osteoarthritis using weightbearing CT scans. The influence of the tibio-talar tilt was additionally assessed.
Methods: We included patients with ankle joint osteoarthritis treated in our institution from January 2013 to April 2016. A control group of 28 patients was additionally assessed. Varus and valgus ankles were subdivided according to the modified Takakura classification and the tilt of the talus in the ankle joint mortise. The type of ankle osteoarthritis was diagnosed on a plain weightbearing anterior to posterior radiograph of the ankle. The medial distal tibial angle (TAS) and the angle between the tibial shaft and the surface of the talar dome (TTS) were measured. The subtalar joint alignment was assessed using weightbearing CT scans. Two angles were assessed: The subtalar inclination angle (SIA) was measured to investigate the subtalar compensation. For assessment of the talar morphology, the inftal-subtal angle (ISA) was determined.
Results: This analysis showed significant differences of the subtalar inclination between varus feet and the controls (SIA, P = .001). Regarding the talar morphology, significant differences were found for both, varus and valgus feet when compared to the controls (ISA, P = .001 and .036, respectively). No significant differences of the subtalar joint inclination and talar morphology could be identified comparing different stages of ankle joint osteoarthritis inside the varus or valgus group. No relationship between the tilt of the talus in the ankle joint mortise and the subtalar joint inclination or talar morphology was identified.

Conclusion: Varus ankles compensate in the subtalar joint for deformities above the ankle joint. The stage of ankle joint osteoarthritis and extent of the tibio-talar tilt had no influence on the compensation. Consequently, the progression of ankle joint osteoarthritis is more depended on the supramalleolar alignment and integrity of soft tissue (i.e. ligaments and tendons) than on the osseous configuration of the subtalar joint.

FM73

Spine surgery education is safe

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Background: Active performance of spine surgery residents (RES) in the operation theatre is a decisive part of their surgical education. However, patient safety is of paramount importance and must not be sacrificed on behalf of thorough education. Thus, reaching the educational goal might become a dilemma, as the performance of residents in the operation room may result theoretically in increased morbidity and less satisfied patients. The aim of this study was to investigate the influence of resident performance on surgical and patient reported outcomes in patients undergoing lumbar procedures.
Methods: This was a single-center retrospective analysis of prospectively collected data within the EUROSPINE Spine Tango Registry, using data from our institution between the years 2004–2015. The study included a total of 1413 patients. Patients operated on by board certified spine surgeons (BCS) served as control group. Patients were divided into three groups based on the surgical procedure they underwent: lumbar single level fusion (SLF): RES n = 60, BCS n = 261, single level decompression for lumbar spinal stenosis (SLD): RES n = 72, BCS n = 245 and surgery addressing disc hernia (DH): RES n = 247, BCS n = 528. Patients completed the multidimensional Core Outcome Measures Index (COMI; 0–10 scale) preoperatively, and 3 and 12 months postoperatively. Multiple linear regression models were used to investigate the influence of resident performance on the outcomes of interest.
Results: There were no differences in surgical or medical complication rates ($p > 0.05$) Blood loss was found to be significantly higher in resident performance only for SLD ($p < 0.05$) and operation time was significantly longer only in DH cases ($p < 0.05$). Length of hospitalization was slightly but not significantly higher in SLF cases ($p = 0.178$). Patient outcome reflected by COMI scores was similar preoperatively for RES and BCS. Scores significantly improved after all three types of procedures ($p < 0.0001$) without difference between teaching cases and control group ($p > 0.05$)
Conclusion: Surgical training of spine surgery residents under guided supervision by board certified spine surgeons is safe as it is not associated with increased morbidity and mortality. Furthermore, patient reported outcome revealed improvement after all three procedure types and is not affected by the teaching cases.

FM74

Muscle relaxation in orthopedic surgery – What does the anesthesiologist measurement with train of four (TOF) tells us?

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Introduction: Orthopedic surgeons often require a full muscle relaxation during surgery. Anesthesiologists use the Hand Train-of-Four (TOF) routinely for assessment of the grade of relaxation and report full relaxation if the TOF becomes zero. Even then, orthopedic surgeons often report an insufficient relaxation. The aims of this study are to determine if TOF hand is superior to TOF foot in quantification of muscle relaxation and which muscles are the first to relax and last to recover.
Methods: Muscle relaxation was prospectively monitored in 12 patients who underwent lumbar spinal fusion using TOF hand and TOF foot as well as motor evoked potentials (MEP) in the upper and lower extremity. After baseline measurements (TOF and MEP), intraoperative boli of intermediate duration non-depolarizing NMBA rocuronium (0.3 mg/kg) was given until full relaxation was achieved. TOF and MEP measurements were performed 10 minutes after each rocuronium bolus from beginning to full recovery of the relaxation. The preliminary results of the first 12 patients are reported.
Results: TOF hand was more resistant to NMBA blockade and had a shorter recovery than TOF foot, indicating TOF hand to be superior to TOF foot in determining intraoperative muscle relaxation. The most resistant muscles to NMBA blockade were abductor digiti minimi > abductor hallucis > extensor hallucis longus = tibialis anterior > deltoid > paraspinal muscles > hip abductors. Fastest recovery from relaxation were observed for abductor digiti minimi > tibialis anterior > abductor hallucis = extensor hallucis lonus > paraspinal muscles > deltoid > hip abdctors. When no twitches were present in TOF hand (TOF = 0) for the first time, MEPs could be detected only in few cases for abductor digiti minimi (n = 4), abductor hallucis longus (n = 3), tibialis anterior (n = 1) and extensor hallucis longus (n = 1). However, in 90% of all measurements (n = 92) no MEPs could be detected as soon as TOF hand was 0.
Conclusion: TOF hand is superior to TOF foot in measuring muscle relaxation. Muscle relaxation occurs first in hip abductors, paraspinal muscles and the deltoid. The most resistant muscle to NMDA blockade was the abductor digiti minimi. Vice versa the first muscle to recover from muscle relaxation was the abductor digiti minimi whereas hip abductors, deltoid and paraspinal muscles were the last muscles to recover. TOF hand adequately represents muscle relaxation particularly for the hip abductors, paraspinal and deltoid muscle.

FM75

Radiation-free measurement tools to evaluate spinal sagittal angle on AIS patients: a validity study

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Introduction: Sagittal imbalance is a common postural malformation, particularly in adolescent idiopathic scoliosis (AIS) patients. Progression of this malformation need to be monitored with precise measurement systems . The gold standard is 2-Dimensional radiography (RX) that exposed patients to radiation. Radiation-free instruments, such as inclinometer (INCL) and rasterstereography (RAST), are available to assess spinal sagittal angles. Reliability of INCL measurement and of RAST for sagittal spinal angles has been documented in healthy volunteers. However, no studie compared the spinal sagittal angle measured using INCL and RAST system with RX. Thus, the aim of this study was to evaluated intra-rater reliability and validity in comparison with the RX, of INCL and RAST to assess spinal sagittal angles on patients with AIS.
Methods: Fifty-one AIS patients were included (13.5 ± 2.0 years, girls = 32 (63%), Cobb angle = 23.0 ± 17.4°, mean BMI = 18.9 ± 2.8 $kg.m^{-2}$). Three repeated measurements of thoracic kyphosis (TK) and lumbar lordosis (LL) were evaluated by the same operator with INCL and RAST the same day of RX examination. Intraclass correlation coefficients (ICC) were used to evaluate reliability of INCL and RAST systems. Additionally, Pearson coefficients were computed between RX and INCL and also between RX and RAST.
Results: Reliability of each radiation-free system was excellent (ICC >0.75 for INCL and RAST) for both TK and LL parameters. Pearson coefficient between each radiation-free systems and RX were moderate for TK ($0.50 < RTK < 0.75$ for INCL and RAST) and low for LL ($RLL < 0.50$ for INCL and RAST).
Conclusions: Firstly, this study demonstrated that the reliability of INCL and RAST free-radiation systems was excellent for TK and LL in AIS patients. Secondly, concerning the validity of these two systems, this study showed a good validity for INCL and RAST to measure the TK using RX as gold standard. However concerning the measurement of LL, the validity was not established. Thus, these two free-radiation systems could be used for clinical follow-up on patients with AIS for evaluation of TK but not for LL.

FM76

Back pain and its change after surgery in adolescents and young adults with adult idiopathic scoliosis (AIS)

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Introduction: The association between back pain and AIS is controversial. Our clinical experience is that a proportion of AIS patients, especially young adults, have relevant back pain. Whether this is related to their deformity and, hence, whether deformity surgery is associated with a relevant reduction in their pain is unclear (1). The influence of age at surgery on back pain relief also remains to be investigated.
Methods: This was a retrospective analysis of prospectively collected data from patients aged 12–30 y, operated for AIS in our hospital from

2005 to 2014 and registered in our local patient outcomes database linked to EUROSPSINE's Spine Tango Registry. Preoperatively and up to 2 years' postoperatively, patients completed the Core Outcome Measures Index, which includes two 0–10 scales for back pain and leg/buttock pain. A score of 4/10 or more is considered "relevant pain" (2).
Results: We identified 85 AIS patients (74 (87%) females) fitting the inclusion criteria. Of these, 60 were aged 12–18 y (mean 15.5 ± 1.7y) and 25 were 19–30 y (mean 22.5 ± 3.1y). There were no significant differences (p >0.05) between the age-groups for coronal Cobb angles of the main curves or Lenke curve types and these curves showed no correlation with pain intensity (p >0.05). Back pain was correlated with age (r = 0.31, p = 0.004). Preoperatively, 42% patients had a back pain score of ≥4/10 (52% in adults, 38% in adolescents). Just 8% patients had a leg pain score of ≥4/10 (16% in adults, 5% in adolescents). Those with notable back pain showed a significant (p <0.0001) improvement 2 yrs after surgery. There was no significant difference in the extent of improvement in older and younger patients (p = 0.22).
Conclusion: In patients with AIS, back pain is correlated with age. In those with relevant back pain at baseline, surgery is associated with a significant alleviation of pain. Skeletally mature young adults benefit as much as adolescents in terms of back pain relief.

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FM77

Revision surgery of symptomatic pseudarthrosis after lumbar fusion: A viable treatment option?

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Introduction: Pseudarthrosis is a feared complication after lumbar fusion that can be associated with pain and disability. The aim of the present study was to investigate outcome, surgical strategy, and preoperative radiographic parameters in patients undergoing revision surgery for symptomatic pseudarthrosis after short lumbar fusion.
Methods: This was a retrospective analysis of prospectively collected data from 91 patients (49 male, 42 female; 54.8 ± 12.6 y at surgery) who had undergone revision surgery between 2005 and 2014. Inclusion criteria were prior lumbar fusion (≤3 segments), symptomatic pseudarthrosis, and at least 6 months' follow-up. Radiographic and surgical data were retrieved from the patient charts. The multidimensional Core Outcome Measures Index (COMI) was completed by the patients, pre and postoperatively, with score differences being analyzed using repeated measures ANOVA.
Results: The mean duration until revision was 35.9 ± 41.4 months. 50/91 patients (55%) had originally been treated at our spine center, and 41/91 (45%) at other hospitals. In 90/91 (99%) patients, posterior fusion had been performed with pedicle or translaminar screws. In 58/91 (64%) patients, the initial interbody fusion was performed with a cage. Screw loosening/breakage was demonstrable in 50/91 (55%) pre-revision radiographs, and 45/62 (73%) available CT images; cage loosening was detected in 21/58 (36%) and 17/58 (29%), respectively. TLIF was used as part of the revision strategy in 76/91 (84%) patients, and PLIF in 8/91 (9%). Screws were exchanged in 90/90 (100%) and cages in 24/58 (41%). BMP was used in 18/91 (20%), and iliac bone graft in 55/91 (60%) patients. 15/91 (16%) patients underwent further revision during the 2-y follow-up. The COMI revealed a small but statistically significant improvement (p <0.01) from 8.6 ± 1.2 pre-revision to 6.6 ± 2.4, 6.6 ± 2.7 and 6.6 ± 2.6 at 3, 12 and 24 months after, respectively. At 24 months, 30/79 (38%) had achieved the COMI minimal clinically important change (MCIC) score of 2.2. points.
Discussion: Revision surgery for symptomatic pseudarthrosis resulted in a small statistically significant improvement in the group mean COMI score, but the proportion reaching a clinically important change after 24 months was low. Revision surgery represents a viable treatment option for some patients. However, both patients and surgeons should be aware of the potentially marked, ongoing impairment at 2 years' follow-up.

FM78

Pull-out strength of patient-specific template-guided vs. free-hand fluoroscopically-controlled thoracolumbar pedicle screws: a biomechanical analysis of a randomized cadaveric study

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Introduction: The implantation of pedicle screws via a patient-specific template-guided versus conventional technique has previously been associated with a higher accuracy, lesser extent of intraoperative radiation, and a reduced instrumentation time. The aim of the present study was to assess the pull-out strength of thoracolumbar pedicle screws implanted via either a patient-specific template-guided or conventional free-hand fluoroscopically-controlled technique in a randomized cadaveric study, and to evaluate the influence of local vertebral bone density, quantified by Hounsfield units (HU), on pull-out strength.
Methods: Thoracolumbar pedicles of 3 spine cadavers were instrumented using either a free-hand fluoroscopically-controlled or a patient-specific template-guided technique. Preoperative bone density was quantified by HU measured on CT. Pedicle perforation and the transverse angulation of screw trajectory were evaluated on postoperative CT scans. After dissected vertebrae were embedded in aluminum fixation devices, pull-out testing was initiated with a preload of 50N and a constant displacement rate of 0.5 mm/sec.
Results: Pull-out strength was significantly different with 549 ± 278 N and 441 ± 289 N in the template-guided (n = 50) versus fluoroscopically-controlled (n = 48) sub-groups (p = 0.031), respectively. Sub-group analysis limited to screws with an intrapedicular trajectory revealed a tendency toward a higher pull-out strength in the template-guided (n = 30) versus fluoroscopically-controlled screws (n = 21) with 587 ± 309 N and 454 ± 269 N (p = 0.118), respectively. Both in the overall analysis (n = 98) and the sub-analysis including intrapedicular screws only (n = 51), the axial screw trajectory was found to be less convergent in the template-guided versus the fluoroscopically-controlled cohort. Axial angulation was 13 ± 5° versus 21 ± 6° in the template-guided versus fluoroscopically-controlled cohort, when including all screws (p <0.001), and 13 ± 6° versus 22 ± 6° when including screws with an intrapedicular trajectory only (p <0.001). There was a trend toward a higher pull-out strength (709 ± 418 N versus 420 ± 149 N) in vertebrae with a bone density of [>171 HU] versus [<133 HU], respectively (p = 0.061).
Conclusions: There was a significantly higher pull-out strength of thoracolumbar pedicle screws when inserted via a patient-specific template-guided vs. conventional free-hand fluoroscopically-controlled technique, potentially associated with an optimal screw trajectory.

FM79

Nasal chondrocytes are potential autologous cell-transplant candidates for treating degenerative disc disease

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Intervertebral disc (IVD) degeneration is one main cause for chronic back pain. Injection of autologous marrow stromal cells (MSC) is still an experimental treatment with limited success so far. Studies show that juvenile chondrocytes display a better cell survival and production of extracellular matrix than MSCs, possibly due to them being more accustomed to an avascular environment similar to the one in the IVD. Recently, it has been shown that adult human nasal septum chondrocytes (NC) have an increased rate of proliferation and synthesis of proteoglycan (GAG) and collagen in contrast to articular chondrocytes (ACs). To assess the potential of NCs as a cell source for autologous cell transplantation therapy in the treatment of IVD degeneration human MSCs, ACs, and NCs were cultured in either normoxic or hypoxic (2% O2) conditions for 4 weeks in 3D pellet culture with chondrogenic media with either regular (4.5 g/l) or low (1 g/l) glucose levels and complemented either with or without the growth factor TGFβ1. Quantification of DNA shows that the cell number of MSC decreased by more than 25% in the absence of TGFβ1 and was barely retained in the presence of the growth factor independent of environmental condition. ACs behaved similar to MSCs with the exception that the cell number increased in hypoxic conditions with the addition of TGFβ1, but independent of the glucose concentration.

Surprisingly, the number of NC slightly increased (>12%) in all conditions without TGFβ1. Furthermore, the supplement of TGFβ1 increased the cell number by at least 48% in any of environmental conditions. Analysis showed that TGFβ1 was necessary for an adequate production of GAG for all three cell sources. The reduction of glucose decreased the level of GAG in pellets formed by MSCs in both hypoxia and normoxia. In contrast, GAG production of ACs was unaffected by changes in glucose concentration, however hypoxic conditions influenced ACs to synthesize more GAG. Interestingly, NCs do not favor hypoxic conditions for GAG production, nonetheless in combination with decreased glucose levels they show a trend to produce the most GAG (35 pgr) compared to ACs and MSCs. Our findings indicate that compared to MSCs and ACs, NCs are more prone to survive and synthesize cartilaginous extracellular matrix in vitro in conditions resembling those of the IVD and are therefore an excellent candidate for a cell based therapy of degenerative disc disease.

***FM80**

Comparison of in vitro osteogenic potential of iliac crest and degenerative facet joint bone autografts for intervertebral fusion in lumbar spinal stenosis

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Introduction: Augmentation of spinal fusion using bone grafts is largely mediated by the osteoinductive potential of mesenchymal stem cells (MSC) that reside in cancellous bone. Iliac crest (IC) is a common autograft, but its use presents an increased risk for donor-site pain, morbidity and infection. Degenerative facet joints (FJ) harvested during facetectomy might servce as an alternative local grafts. In this study, we conducted an intra-individual comparison of the osteogenic potential of MSC from both sources.
Methods: IC and degenerative FJ were harvested from 8 consecutive patients undergoing TLIF due to lumbar spinal stenosis. MSC were isolated by collagenase digestion, selected by plastic adherence and minimally expanded for downstream assays. Clonogenic and osteogenic potential was evaluated by colony formation assays in control and osteogenic culture medium. Osteogenic properties, including alkaline phosphatase (ALP) induction, matrix mineralization and type I collagen mRNA and protein expression were characterized using quantitative histochemical staining and reverse transcription PCR. Spontaneous adipogenesis was analysed by adipocyte enumeration and gene expression analysis of adipogenic markers.
Results: Average colony-forming efficiency in osteogenic medium was equal between IC (38 ± 12%) and FJ (36 ± 11%). Osteogenic potential at the clonal level was 55 ± 26 and 68 ± 17% for IC and FJ MSC, respectively. Clonogenic and osteogenic potential were significantly negatively associated with donor age. Osteogenic differentiation led to significant induction of ALP activity in IC (6-fold) and FJ (8-fold) MSC. Matrix mineralization quantified by Alizarin red staining was increased by osteogenic differentiation, yet similar between both MSC sources. Protein expression of type I collagen was enhanced during osteogenesis and significantly greater in IC MSC. Correspondingly, COL1A2 mRNA expression was higher in osteogenically differentiated MSC from IC. Adipocyte numbers showed significant differences between IC (63 ± 60) and FJ (18 ± 15) MSC under osteogenic conditions. Negative (GREM1) and positive (FABP4) adipogenic markers were not differentially expressed between sources.
Conclusion: MSC from IC and degenerative FJ largely display similar clonogenic and osteogenic properties in vitro. Differences at the molecular level are not likely to impair the osteoinductive capacity of FJ MSC. Facetectomy samples are viable bone autografts for intervertebral spinal fusion.

***FM81**

Analysis of osteoarthritis-specific structural changes of subchondral bone in degenerative lumbar facet joints

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Introduction: Facet joint osteoarthritis (FJOA) is a prominent clinical hallmark of degenerative spine disorders. During disease progression, cartilage and subchondral bone tissues undergo increased turnover and remodeling. The structural changes to the subchondral tissue of FJOA have not been studied thus far. In this study, we performed a micro computed tomography (μCT) study of the subchondral cortical plate (SCP) and trabecular bone (STB) in FJOA and determined osteoarthritis-specific alterations.
Methods: Twenty-four patients (11 male, 13 female, median age 65) scheduled for decompression and stabilization surgery for degenerative spinal stenosis were included in this study. FJOA specimens were harvested during surgery and analyzed by μCT. Bone volume fraction (BV/TV), trabecular thickness (Tb.Th), trabecular separation (Tb.Sp) and trabecular number (Tb.N) were evaluated using CT Analyser. Lumbar facet joints without chondropathy from cadaveric specimens (9 male, 6 female, median age 57) served as healthy controls. Age-, gender- and disease-specific effects were identified by ANOVA ($p < 0.05$) and significant differences confirmed by Bonferroni's post-test. Association between age and structural parameters was determined using correlation analysis.
Results: Cortical and trabecular bone structural parameters of FJOA were similar between males and females. Compared to healthy controls, FJOA specimens demonstrated significantly greater trabecular Tb.N (1.97 ± 0.11 vs 1.24 ± 0.04 mm^{-1}) and decrease of Tb.Sp (0.44 ± 0.03 vs 0.69 ± 0.03 mm). Conversely, subchondral cortical plate thickness (0.62 ± 0.08 vs 1.60 ± 0.08 mm) and porosity (22.9 ± 1.9 vs 31.5 ± 2.1%) were significantly less compared to healthy specimens. Tb.Th was equal between patients and controls. Age was positively correlated with Tb.N ($r = 0.48$, $p = 0.02$) and negatively correlated with Tb.Sp ($r = –0.44$, $p = 0.03$) and cortical plate thickness ($r = –0.52$, $p = 0.04$) in FJOA. Cortical plate thickness did not correlate with trabecular bone parameters in healthy and osteoarthritic facet joints.
Conclusion: FJOA bone remodeling is characterized by thinning of the SCP and an increase in the number of subchondral trabeculae. Remodeling of cortical and trabecular bone might occur in an uncoupled fashion. Targeting elevated subchondral bone remodeling might slow progression of lumbar FJOA.

***FM82**

Do patient-rated outcomes after surgery for lumbar degenerative spondylolisthesis depend on the appropriateness of surgery?

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Introduction: In spine surgery, many treatment failures are attributable to poor patient selection and the application of inappropriate treatment. "Appropriate use criteria" (AUC) serve to help clarify the indications for a procedure. This study aimed to use recently published AUC (1) to evaluate the appropriateness of surgery for lumbar degenerative spondylolisthesis (LDS) in a large group of patients and to examine the association between adherence to the criteria and postoperative outcome.
Methods: This was a retrospective analysis of prospectively collected data recorded in our Spine Outcomes database (linked to EUROSPINE's Spine Tango Registry) from patients who had undergone LDS surgery in our clinic, 2005 to 2012. Appropriateness of the use of surgery in each patient was judged using the published criteria (1). Patients completed the Core Outcome Measures Index (COMI) before surgery and at 3, 12 and 24 months follow-up (FU).
Results: In total, 537 patients (age 69 ± 10 y; 384 (72%) women) were eligible for inclusion. 98% completed a COMI form preoperatively, 96% at 3 mo FU, 92% at 12 mo FU, 90% at 24 mo FU. We were able to apply the appropriateness criteria in 475/537 (88 %) patients with the necessary baseline data. Some type of surgery (either decompression or fusion ± stabilisation) was considered appropriate in 224 (47%) of the operated patients, inappropriate in 95 (20%), and uncertain in 156 (33%). There was a significant difference between the groups in the pattern of change in COMI score from preoperatively to follow-up ($p < 0.001$) whereby patients who were considered appropriate (A) or uncertain (U) candidates had greater improvements in COMI than those who were considered inappropriate (I) candidates. The minimal clinically important change (MCIC) score of 2.2 points for COMI was reached by 78% A, 83% U and 55% I cases ($p < 0.001$, I vs A and U). The odds of achieving the MCIC was 3-times greater in patients considered appropriate/uncertain for surgery than in those considered inappropriate (OR 3.4 95%CI 1.99–5.63).
Conclusions: The results suggest a relationship between adherence to the AUC and outcome. The findings provide support for the use of AUCs in clinical practice, to guide indications for surgery, but the findings should be confirmed in prospective studies that also include a control group of non-operated patients.

References

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FM83

Severity of foraminal lumbar stenosis and the relation to clinical symptoms and response to periradicular infiltration – Introduction of the "melting sign"

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Introduction: Nerve root compression causing symptomatic radiculopathy can occur within the intervertebral foramen. Sagittal MRI sequences are reliable in detection of nerve root contact to intraforaminal disc material, but a clinically relevant classification of degree of contact is lacking. The purpose was to investigate a potential relation of amount of contact between intraforaminal disc material and nerve root to clinical findings and response after periradicular corticosteroid infiltration.
Methods: T2-weighted MR images of the lumbar spine of patients with single level symptomatic radiculopathy with (responders, n = 28) or without (controls, n = 14) pain relief after periradicular infiltration with corticosteroids were measured and compared by two independent readers to determine the amount of intraforaminal nerve root contact with the intervertebral disc ("melting" of the T2-hypointense signal). Pain relief was defined with a pain level decrease of >50% on a visual analogue scale and lack of pain relief with a pain level decrease of <25%, respectively. The amount of T2-hypointensity melting of disc and nerve root was categorized to 0%, 1–25%, 26–50% and over 50%.
Results: Reader one identified 0% T2-melting in none of the patients, 1–25% melting in 13 (46.4%) patients, 26–50% in 15 (53.6%) of the 28 patients with pain relief after periradicular infiltration (responders) with a mean amount of T2-melting of 5.9 ± 2.1 mm. Whereas the control group had 0% T2-melting in 2 (14.3%) patients, 1–25% T2-melting in 11 (78.6%) patients and 26–50% in 1 (7.1%) patient with a mean amount of T2-melting was 2.6 ± 1.9 mm ($p < 0.05$). Reader two identified 0% T2-melting in none, 1–25% T2-melting in 15 (53.6%) and 26-50% in (46.4%) 13 of the 28 responders, with mean amount 6.3 ± 1.9 mm. In the control group 0% T2-melting was seen in 3 (21.4%) patients, 1–25% T2-melting in 10 (71.4%) patients and 26 – 50% in 1 (7.1%) patient with a mean amount of T2-melting of 2.7 ± 1.9 mm ($p < 0.05$). None of the MR images showed T2-melting in over 50 percent of the circumference of the intraforaminal nerve root. A T2-melting of >25% had a high specifity of 93% but a sensitivity of 54%, thus a positive likelihood ratio of 7.5, to identify those with a pain relief of more than 50% after infiltration.
Conclusion: The amount of T2-melting of disc material and nerve root on sagittal MRI (>25%) predicts the amount of pain relief by periradicular infiltration in patients with intraforaminal nerve root irritation.

FM84

Harlequin sign concomitant with Horner syndrome after anterior cervical discectomy: intrusion into the cervical sympathetic system

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Introduction: Harlequin syndrome is a rare autonomic disorder referring to a sudden development of flushing and sweating limited to one side of the face. Like Horner syndrome, it is caused by disruption of cervical sympathetic pathways.
Case Report: A 55-year-old female patient presented with both conditions (right-sided hemifacial flushing with sweating associated with left-sided hemifacial anhidrosis, miosis and ptosis) immediately after left-sided anterior cervical discectomy (C6-C7) with cage fusion and anterior spondylodesis. The urgently performed cerebral and cervical CT-angiography ruled out any ischemic or local complications, but revealed a very close position of the drain to the left sympathetic trunk. Therefore, we suspected a probable irritating and/or compressive effect of the drain, which was instantly removed. Vasomotor and sudomotor symptoms disappeared entirely after only a few hours and the Horner syndrome had completely resolved at the 10 month follow-up.
Discussion: Harlequin syndrome results from a dysfunction of the sympathetic vasodilator and sudomotor fibers innervating the face on the ipsilateral side of the affected sympathetic pathways. The underlying mechanism involves a contralateral compensation for the loss of sympathetic activity on the injured side. Harlequin syndrome can be idiopathic, secondary (e.g. tumoral or vascular compression) or iatrogenic in origin. It usually involves the face, but can extend to the ipsilateral arm or trunk. The location of the lesion along the sympathetic pathways, consisting in a three-neuron chain, determines the pattern of symptoms presented by the patient. In our case, the identified cause of sympathetic disruption was probably a too laterally situated dissection, which allowed the drain to be in contact with the sympathetic trunk and press on it while following the path of smallest resistance. In the iatrogenic cases described in literature, the symptoms appeared temporary and resolved mostly within a few hours. In absence of organic cause, no specific treatment is available.
Conclusion: Despite its most often benign and reversible nature, this phenomenon can be quite impressive for both patient and surgeon. Knowledge of Harlequin syndrome should be of particular interest for every specialist involved in cervical and thoracic surgery.
Note: This case report has been accepted for publication in Journal of Neurosurgery: Spine.

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*FM85

Extreme lateral interbody fusion approach to treat a single level incomplete burst fractures of the thoracolumbar spine: 24 months results in 15 consecutive cases

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Introduction: Thoracolumbar burst fractures can cause debilitating pain, restricting mobility and negatively impact the patient's overall quality of life. Surgical intervention allows for immediate fracture stabilization for early mobilization and return to activities. Two methods of minimally invasive surgery (MIS) procedures are pedicle screws placed percutaneously and the extreme lateral interbody fusion (XLIF) approach whereby the surgical corridor is created via an expanded retractor. The study purpose was to review radiographic outcomes for patients being treated for single-level thoracolumbar burst fractures via the XLIF approach.
Methods: This was a retrospective non-randomized review of 15 patients (9M, 6F) suffering from single-level thoracolumbar burst fractures (ASIA E) classified as MagerI A3.1. These fractures were treated posteriorly by open or percutaneous screw placement followed by the MIS XLIF procedure to place a PEEK interbody spacer just superior to the level of the fracture. Radiographic measures were taken preoperatively, postoperatively and at latest followup to evaluate the stability of the construct.
Results: The average patient age was 42 years with average 21 month followup. Patients had an average BMI of 26. Eight patients had same day surgeries while seven were staged. The average hospital stay was 12 days. Injured levels were as follows T12 (n = 5), L1 (n = 6), L2 (n = 3) and L5 (n = 1). Smoking was identified in 40% (n = 6) of patients. All patients returned to work and 80% were very satisfied with the outcome and would recommend the surgery. The other 20% stated that the surgery helped and were satisfied. For radiographic outcomes, the preoperative kyphosis angle was 16.8°+28.2 and the bisegmental angle was 7.6° + 14.4 while the postoperative kyphosis angle was 6.2° + 5.6 ($p = 0.1$ compared to preop) and bisegmental angle was 0.8° + 13.9 ($p = 0.2$ compared to preop). When comparing the postoperative angles to those at latest follow up, there were no differences between the postoperative angles and those at followup for kyphosis angle 6.7° + 4.9 and bisegmental angle 4.9°+12.3.
Conclusion: The XLIF technique appears to be a viable MIS option for treating single level thoracolumbar burst fractures. Patients achieved relief of pain, all returned to work and were satisfied with their outcomes. The placement of pedicle screws followed by interbody placement provided radiographic correction postoperatively and maintenance of correction at latest follw up.

FM86

Flat bed rest vs. immediate mobilization after incidental durotomy in spine surgery: preliminary results of a randomized controlled trial

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Introduction: Incidental durotomy (ID) is a frequent complication during spinal surgery. Persisting leakage of cerebral spinal fluid (CSF) can occur even after ID-repair and requires revision surgery. Prolonged flat bed rest with intention to reduce hydrostatic pressure at the repair site is proposed but debated to reduce the occurrence of CSF leakage after ID-repair. A RCT is lacking comparing prolonged bed rest versus immediate mobilization after ID-repair.
Methods: Thirty-nine patients (mean age of 64 ±13 years) undergoing lumbar spinal surgery complicated by ID and immediate repair were consecutively randomized to either immediate postoperative

mobilization (n = 23) or flat bed rest for 48 hours (n = 16). The adherence to the mobilization regimen was controlled with a motion tracking system. Indications for revision surgery were clinical symptoms, a semi quantitative analysis using glucose sticks and/or Beta transferrin confirming CSF leakage. The rate of revision surgery, medical complications, duration of hospitalization, as well as tear size were compared between groups.
Results: One patient in the bed rest group underwent revision surgery because of persistent CSF leakage while none of the patients in the early mobilization group required further surgical interventions. Two patients in the flat bed rest group experienced medical complications (pneumonia and cerebral ischemia). There was only a slight difference in duration of hospitalization (6 ± 2 vs. 8 ± 4 nights) and no differences in tear size (3.26 vs. 4.07 mm) in the early mobilization group compared to the bed rest group, respectively.
Conclusion: Preliminary results of the here presented only available randomized controlled trial indicate no benefit of prolonged bed rest in patients undergoing spine surgery complicated by ID. The study is being continued to minimize the potential of a sample size bias.

FM87

Diagnostic accuracy of magnetic resonance imaging for diagnosis of spondylolysis in children and young adults: a Systematic Review and Meta-Analysis

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Introduction: Spondylolysis is often described as a stress fracture in young people and accurate diagnosis is widely made with scanner (CT) considered as the gold standard. However CT represents significant radiation exposure particularly substantial in a young population. Although the role of magnetic resonance imaging (MRI) in identifying edema/inflammation within the pars as an active lesion is proved, its ability to demonstrate and classify pars fracture as same as CT still controversial. A meta-analysis was performed to determine the sensitivity and specificity of MRI in the diagnosis of spondylolysis in young patients, taking in account direct visualisation of the pars defect.
Methods: Pubmed and Embase databases were systematically searched for relevant studies from the earliest researchable time to 15 March 2016 in which accuracy of MRI was reported for the diagnosis of spondylolysis in young patients. Two reviewers independently assessed the methodologic quality for each selected study, by using the quality assessment of diagnostic accuracy studies 2 (QUADAS2) tool. A meta-analysis of the reported sensitivity and specificity of pooled data of selected studies by the systematic review was performed. Hierarchic summary receiver operating characteristic curve was generated to estimate the diagnostic performance of MR imaging on. Heterogeneity was also tested.
Results: The systematic review included in the meta-analysis a total of four of 1300 initially studies identified. On a per-pars basis (a total of 1122 pars) the pooled sensitivity and specificity of MRI for the diagnosis of spondylolysis were respectively 81% (95%CI: 54 to 94%) and 99% (95% CI: 98% to 100%) respectively. A high overall heterogeneity (I2 = 79.5%) was computed with respectively high and low heterogeneity on sensitivity (I2 = 87.9%) and specificity (I2 = 38.4%).
Conclusion: This meta-analysis demonstrated high diagnostic performance of MR imaging for the diagnosis of spondylolysis in young adults. It may be considered as a first line imaging as it helps to avoid exposure to ionizing radiation. Diagnostic of spondylolysis using MR imaging showed high sensitivity and specificity among a total of 1122 pars of children and young adolescents which can reduce considerably ionizing radiation exposure.

***FM88**

Choice of acromioclavicular stabilization technique affects stability of the acromioclavicular joint

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Background: Acute acromioclavicular (AC) disjunction disrupts rotational and translational control on the scapula by the acromioclavicular and coracoclavicular ligamentous complexes. Data remain limited about efficiency of the different existing acromioclavicular stabilization technique at resisting translational and rotational forces.
Objectives: Assessment of the impact of 4 different constructs on stability about the AC joint.
Methods: Two synthetic bone models were equipped with coracoclavicular repair devices. Horizontal tunnels were drilled at he margins of the AC joint on one model and vertical tunnels were drilled on the second one. Bone models were equipped with navigation tracking devices on the clavicle and acromion. Rotational and translational stability of the constructs were tested with nondestructive quasi-static tensile tests in abduction/adduction, flexion/extension, external/internal rotation and inferior translation. Displacing forces were applied using a force transducer. Measurements were carried with the coracoclavicular device alone (CC). Stabilization was then achieved by 4 different types of constructs using tape sutures; (O) horizontal cerclage alone, (8) horizontal figure of eight alone, (O8) horizontal cerclage reinforced with a figure of eight, and (V) vertical cerclage alone. Total displacement between clavicular and acromial tracking devices was recorded in a kinesiology laboratory and normalized using values measured with the force transducer during motion. Total displacement was computed as the sum of all normalized rotations and translations.
Results: Total displacement (mean ± SD mm/N) was 9.67 ± 12.56 for CC repair alone, it was 1.3 ± 0.64 for horizontal cerclage, 1.6 ± 1.58 for figure of eight; 0.95 ± 0.79 for horizontal cerclage associated with figure of eight and 3.31 ± 3.04 for vertical cerclage. Total displacement was significantly inferior for O8 constructs than for all other constructs ($p < 0.000 – 0.014$). No statistical differences were found between O and 8 constructs ($p = 0.09$) as well as vertical cerclage and coracoclavicular cerclage alone ($p = 0.06$).
Conclusion: Horizontal cerclage of the AC joint associated with figure of eight allows for significantly increased resistance to rotational and translational displacement forces in comparison with other tested constructs. Further study is required to assess resistance of the constructs to cyclic loading.

FM89

The anterior borders of the clavicle and the acromion are not always aligned in the intact acromioclavicular joint

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The aim of this study was to find reliable anatomical landmarks of the normal acromioclavicular joint (ACJ) that could enable the precise evaluation of the horizontal displacement of the clavicle after dislocation. The hypothesis was that the anterior borders of the acromion and the clavicle are always aligned in intact ACJs.
Materials and methods: In 30 cadaveric specimens, the anterior and posterior borders of the ACJ's articular facets and the most prominent anterior and posterior bony landmarks of the acromion and the clavicle were identified. The anterior and posterior overhang of the acromion and the clavicle was measured relating to the borders of the articular facets. Therefore, the possible anterior and posterior alignment of the ACJ was evaluated.
Results: Anteriorly only eighteen (60%) AC joints were aligned while 7 (24%) had major overhang of the acromion and 3 (10%) had a major overhang of the clavicle. Similarly, eighteen cases (60%) were posteriorly aligned while 6 (20%) had major clavicular overhang and 4 (14%) had a major overhang of the acromion. In 78% of these cases the AC joint was aligned as well anteriorly as posteriorly ($p < 0.001$). Finally, the larger the width of the acromion ($p = 0.032$) or the clavicle ($p = 0.049$) that better was the posterior joint alignment.
Conclusion: Our hypothesis was not verified. The acromion and clavicle are not perfectly aligned in a significant number of specimens with intact ACJ (40% of cases). The most reliable landmarks remain their articular facets.

FM90

Statistical shape modeling for the prediction of the pre-traumatic anatomy of the proximal humerus

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Introduction: The benefit of three-dimensional (3D) computer-assisted planning for corrective osteotomies of complex malunited humeral fractures has been demonstrated in previous studies. In the state-of-the-art template-based approach, the mirrored model of the contralateral anatomy serves commonly as a reconstruction template. However, existing intra-individual bilateral differences or a pathological contralateral humerus may limit the applicability of the method. The aim of the study was to evaluate whether a computer-generated model has the potential to predict accurately the pre-traumatic anatomy of the humerus from the posttraumatic condition.
Methods: 3D triangular surface models were extracted from computed tomographic data of 50 cadaveric humeri. A statistical shape model (SSM) was constructed, encoding the characteristic shape variations

among the individuals. To predict the pre-traumatic anatomy of the proximal part of the humerus with the SSM, we generated segments of the distal humerus of predefined length excluding the part to predict. The proximal prediction errors, defined as the deviation of the predicted anatomy from the original bone mode, were evaluated. For comparison with the state-of-the-art we evaluated whether, based on the same segments of the humerus, the SSM or the contralateral anatomy yields a more accurate reconstruction template.
Results: The mean proximal prediction error was 3.8° (SD 1.9°), when 85% of the distal humerus were used to predict the pretraumatic anatomy of the humeral head. The error was significantly smaller ($p < 0.0001$) compared to the reference method. The errors in the prediction of the humeral length did not differ significantly between the SSM and the reference method.
Conclusion: SSMs are powerful tools, accurately predicting the patient-specific pre-traumatic anatomy of the proximal humerus, especially if only the articular part of the humerus is pathological.

FM91

The humeral anatomic neck can be determined accurately and reproducibly in 3D-CT models

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Introduction: Although determination of the anatomic neck on 3D-CT scan is a central principle when designing anatomical implants in shoulder arthroplasty and analysing their biomechanical impact on joint biomechanics, this method has not been validated yet. We hypothesized that manually determination of the anatomic neck in cartilage free 3D-CT models represents an accurate and reproducible method.
Methods: The anatomic neck of 12 nonpathologic cadaveric humeri was digitized in the laboratory and referenced back on the corresponding 3D-CT model. Retroversion and inclination angles were calculated to define the true anatomic neck plane orientation (tNPO). Without providing any information of the tNPO three independent observers- one medical student (MS) and two orthopaedic surgeons (OS)- independently determined the anatomic neck by manually setting points on the bony 3D-model. These sets of reference points were used to calculate retroversion and inclination to determine the manually defined anatomic neck plane orientation (mNPO). All specimen were evaluated a second time by a single observer 4 weeks later. Accuracy was determined by comparing retroversion and inclination angles of the tNPO and mNPO for each observer using paired t-tests. Intraclass correlation coefficients (ICCs) were calculated to assess intra- and inter-observer reliability.
Results: Retroversion and inclination angles in the tNPO were 37 ± 8° and 133 ± 3°, respectively. Retroversion was different ($p = 0.02$) in tNPO and mNPO if defined by the MS, but not if determined by the two OS ($p \geq 0.21$). No differences were found for inclination between tNPO and mNPO for all observers ($p \geq 0.16$). Intraobserver reliability was almost perfect (ICC=0.90) for retroversion and substantial (ICC = 0.74) for inclination. Interobserver reliability ranged from substantial to almost perfect for retroversion and inclination. The highest ICC was found for retroversion between the two OS, the lowest ICC was found between the MS and the OS for inclination (ICC = 0.52).
Conclusion: Anatomic neck orientation can be accurately defined in 3D-CT models. Detailed knowledge about cartilageneous topography of the humeral head seems to influence accuracy and reproducibility of this kind of measurements. This must be considered in further studies evaluating prosthetic designs in shoulder arthroplasty or patient-specific preoperative 3D-CT based planning.

FM92

Applicability and clinical 1-year-results of an evidence-based treatment algorithm for proximal humerus factures – a prospective analysis

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Introduction: To help with the decision making for proximal humerus fractures (PHF), we developed an evidence-based algorithm which includes patient's demands, bone quality and fracture morphology. It was the aim of this prospective study to assess its applicability and clinical outcome.
Materials and Methods: From January 2014 until December 2015, all patients with isolated, non-pathologic proximal humerus fractures were asked to participate. At the time of fracture, the patients reported their quality of life (EQ-5D) and their level of autonomy before the injury. The fractures were classified (X-ray or CT) and the local bone quality measured (X-ray). If possible, the patients were treated according to the algorithm, which includes conservative treatment, ORIF, hemi- (HA) or reverse shoulder arthroplasty (RTSA). Radiographic and clinical (EQ-5D, subjective shoulder value (SSV), Constant score (CS)) follow-up took place after 3 months and 1 year. Complications and revisions were analysed.
Results: A total of 193 patients (mean age: 66y; 18–97, 135 female, 58 male) could be included. 83% of the patients had a complete 1y follow-up. 161 patients (83%) were treated according to the algorithm. We classified 84 (44%) 1-part, 76 (39%) 2-part, 16 (8%) 3-part and 18 (9%) 4-part fractures. 132 (68%) patients were treated conservatively, 38 (19%) with ORIF and 24 (13%) with prosthesis. Overall, the mean quality of life was the same before trauma and 1y after treatment (EQ-5D: 0.9 to 0.9) and the mean 1-year clinical sores were: CS 73pts and SSV: 84%. The overall complication rate was 17% (n = 33), with a revision rate of 14% (n = 28). Only 3% (n = 4) of the conservatively treated patients needed later surgery. Most of revision surgeries (n = 23) were needed in the ORIF and the HA group, whereof most were plate removals (n = 11).
Conclusion: The adherence to the algorithm was high and it turned out to be a helpful tool for the decision making in a teaching hospital. Furthermore, the patient specific treatment helped to bring back the patients to their pre-injury quality of life with mainly good clinical results. Whereas the decision pathways for conservative treatment seem to be successful, patients selected for ORIF or HA, still have a high revision rate, thus the surgical technique and the algorithm might be improved in this regard.

***FM93**

The influence of local bone quality on fracture pattern in proximal humerus fractures

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Introduction: The significance of bone mineral density in the treatment of proximal humerus fractures has been widely discussed in the literature. Also the fracture pattern is a relevant factor when considering the different treatment options for these fractures. It was the aim of this study to assess the influence of local bone mineral density on the fracture pattern in proximal humerus fractures.
Methods: From January 2014 to August 2015 we prospectively analyzed all acute, isolated and non-pathological proximal humerus fractures admitted at our emergency department. Two independent board certified orthopaedic trauma surgeons retrospectively classified the fractures according to Neer and measured the humeral head impaction angle (varus/valgus). On the fracture X-ray we also assessed the local bone quality using the Deltoid Tuberosity Index (DTI). Chi-squared test was used to analyse the distribution between DTI and fracture pattern.
Results: 191 proximal humerus fractures were included in the study (61 men, mean age 59 years, range 15–91 years; 130 women, mean age 69.5, range 19–99). 77 fractures (40%) were classified as one-part, 72 (38%) were two-part, 24 (13%) were three- and four-part and 18 (9%) were fracture dislocations. 30 fractures (16%) were varus impacted, whereas 45 fractures (24%) were classified as valgus impacted. The mean DTI was 1.48 (SD = 0.19, range 1.11–2.35). Valgus fracture impaction significantly correlated with good bone quality (DTI >= 1.4; $p = 0.047$) whereas no such statistical significance was found for the Neer fracture types.
Conclusion: This is the first study comparing bone quality and fracture morphology. We found that valgus impaction significantly depended on good bone quality. However, neither varus impaction nor any of the Neer fracture types correlated with bone quality. We conclude that the better bone quality of valgus impacted fractures may be a reason for their historically benign amenability to ORIF. On the other hand good local bone quality does not prevent fracture comminution.

*FM94

One year results of the first 100 patients treated with a new anatomical precontoured locking plate for clavicular fractures

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Introduction: Precontoured locking plates are recently introduced in the management of clavicle fractures. These plates offer many advantages such as no need for intraoperative bending of the plates, reduced plate irritation and provide biomechanically more stability than conventional plates or nails. We reviewed the first 100 patients treated with Stryker VariAx clavicle locking plate for clavicular fractures with a minimum follow-up of 1 year.
Methods: In a retrospective, single-center study 100 patients (16 female, 84 male) with a median age of 40 years (range 15 – 82) who underwent surgery for clavicular fractures with a VariAx locking plate between 03/2012 and 01/2016 were included. Postoperative follow-up was performed until union was clinically and radiographically achieved. Fracture type, surgical time, intraoperative need for contouring the plate, further surgery such as revision or hardware removal and complications were recorded.
Results: 100 patients with 95 dislocated midshaft, 4 lateral and 1 medial clavicular fractures and 2 open fractures were included. Median surgical time was 75.5 min (range, 35–179). In 3 patients, intraoperative bending of the plate was necessary. In 2 patients plates designed for the other side were implanted. 5 patients needed revision surgery. One patient had wound healing problems that was revised. One patient was treated for postoperative frozen shoulder. One patient had a refracture after early (13 months) hardware removal and trauma and in two patients osteosynthesis failed because of surgical reasons. One of these patients was revised with a VariAx plate while the second patient was revised with another implant. Both of them had no further problems in follow-up. Two non-unions without further treatment were observed. In 23 patients, plate was removed after a median of 18 months (range, 11–31) because of subjective plate discomfort.
Conclusions: With this new precontoured locking plate good to excellent intraoperative fit to the anatomical shape of the clavicle can be achieved. The implant seems to be reliable in regard of handling and complications. Clinical and radiological results are very good and the rate hardware removal in our cohort is comparable to the literature.

FM95

Indication for clavicle fracture osteosynthesis based on shortening: How to measure it?

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Introduction: Indication for midshaft clavicle fracture surgery is based on shortening evaluated on standard radiographs. This method may not be reliable because shortening result from three-dimensional displacement of fragments. Our first objective was to assess reliability and accuracy of three previously described clavicle fracture shortening measurements recorded on standard radiographs and compared to CT with 3D reconstruction and virtual reduction. The second objective was to assess impact of fracture pattern on shortening.
Methods: We created five synthetic fractured bone models and acquired standard radiographs and CT. Shortening measurements were validated comparing fractured and reduced states with a caliper and after virtual reduction on dedicated 3D reconstruction software. Twenty patients with midshaft clavicle fractures imaged by standard radiographs and CT because of polytrauma were then retrieved. Shortening was measured independently by a musculoskeletal radiologist and an orthopedic surgeon according to three methods (Jeray, Silva and Smekal et al.). Measures were compared to the ones recorded on 3D reconstruction. The effect of fragments displacement according to 6 degrees of freedom on shortening was finally correlated to shortening in order to assess impact of fracture pattern.
Results: Mean difference in shortening between caliper and CT was 0.7 mm [–2.5; 4.0] ($p = 0.56$). Inter-observer reliability was 0.99 for Jeray, 0.97 for Silva and 0.97 for Smekal. Mean difference between CT and standard radiographs was 11.7 mm [7.1; 16.4] for Jeray, –1.2 mm [–5.9; 3.4] for Silva and 9.1 mm [4.5; 13.7] for Smekal. The results based on a mixed linear model didn't show significant difference between Silva and CT measurements ($p = 0.51$). The only component of fracture pattern significantly associated with shortening was the translation about the axis (z).
Conclusion: Clavicle fracture shortening measured on CT has an accuracy of 2–4 mm when compared to direct measures. Radiographic measurement according to Silva et al. achieved good inter-observer reliability and an accuracy of 4 to 6 mm. We recommend its use for further studies. Fracture pattern according to 6 degrees of freedom did not influence shortening in this model. We cannot recommend its assessment for indication to therapeutic modality.

FM96

Use of a cortical button with the double incision technique for distal biceps tendon avulsion – the importance of the correct drill trajectory

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Introduction: The double incision technique is an established approach for distal biceps tendon fixation and more reliable for anatomical reconstruction then the single anterior approach. Reattachement can be achieved either with transosseous sutures or anchors. However, the strongest fixation is achieved with a cortical button and this technique, applied through the single anterior approach has gained increasing acceptance. For the double incision technique the forearm has to be kept in full pronation to expose the radial tuberosity in the posterior approach. Cortical buttons may be used with this technique as well. However, there is no data available about a potential interference of the cortical button with the posterior interosseous nerve (PIN) when the double incision technique is used.
Methods: A double incision approach was performed in 10 fresh cadaveric elbows. Nine different bicortical posterior drill trajectories through the radial tuberosity were analyzed (perpendicular, distally, proximally, radially, ulnarly and the combinations of the former). The forearm was kept in full pronation for the drilling. The shortest distance between the PIN and the drill tip was measured for all examined trajectories. Accordingly, the shortest distances between the PIN and the BicepsButton™ were measured for all trajectories as well.
Results: The safest trajectories with the longest distances between the drill tip and the PIN were observed with the distal-ulnar (mean 14 mm [range 6–20 mm]) and ulnar (10 mm [6–17 mm]) trajectories. Only the ulnar trajectories (ulnar/proximal ulnar/distal ulnar) did not interfere with the PIN in any specimen. Regarding the BicepsButton™ with a size of 12×4 mm, mean distance decreased to 10 mm (range 2–16 mm) and 6 mm (range 2–13 mm) for the distal-ulnar and ulnar trajectory, respectively. All other trajectories had a least one possible interference of the BicepsButton™ with the PIN.
Conclusion: Bicortical drilling for cortical buttons should be aimed in a distal-ulnar direction when the posterior approach is used to achieve a safe distance between the button and the PIN. Even with this trajectory, the shortest distance using the BicepsButton™ was measured only 1.6 mm in this study.

FM97

The minimal difference of elbow arc of motion needed for statistical significance in clinical studies using rounded data

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Introduction: Visually measured range of motion (ROM) data are usually rounded to the nearest 5° interval and then recorded. For two sided ROM measurements, like elbow arc of motion, rounding is usually performed on both sides: flexion and extension. These data transformations reduce the information content which potentially introduces errors in statistical analysis.
Methods: We performed with R Statistical Package numerical simulation of t-test application on two data sets, as typically reported for elbow flexion-extension arc of motion. The test was performed on exact data and then repeated on the same data rounded to the nearest 5° interval. Simulation input parameters were: difference of means (1–30), standard deviation (1–30) and number of cases (15, 30, 60 and 120). Diverging results were counted in order to find the rate of failure.
Results: Depending on the given difference of means, the given standard deviation and on the number of cases the failure rate of the t-test after rounding reached up to 40%. The minimal difference of means needed for reliable t-test application depended on sample size and standard deviation. By increasing the number of cases the transition zone between true significant and true non-significant results gets steeper and lower, but rounding still caused up to 20% failure of the t-test.
Conclusion: The accuracy of statistical tests on rounded ROM data is limited due to loss of information after quantization to the nearest 5° interval. This affects parametric and non-parametric tests, paired and unpaired tests, superiority and non-inferiority trials, as well as

measurements with one-sided rounding and two-sided rounding like arc of motion. Potentially false conclusions might be published and consequently incorporated in clinical practice if rounding error is not controlled. In the future, the authors should specify how ROM has been measured and recorded, explicitly addressing rounding. Furthermore, they should test our new quantization assumption before continuing with comparative statistics.

FM98

Level of the subscapularis split during arthroscopic latarjet

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Introduction: During arthroscopic Latarjet the level of the subscapularis split may be established from an inside-out or inside-out technique. The aim of this cadaveric study was to determine the location of the split created by an inside-out technique passing a switching stick from the posterior portal across the glenohumeral joint. The hypothesis was that this "inside the box" split would occur at the junction of the middle and inferior third of the subscapularis.
Methods: An inside-out technique was used to arthroscopically create a subscapularis split in 20 fresh-frozen human cadaveric shoulders. The distance between the exit point of the switching stick and the upper border of the subscapularis and the anterior circumflex vessels was measured arthroscopically and following open dissection.
Results: Twelve splits were in the upper third of the subscapularis, 3 were at the junction of the upper third and the middle third, and 5 were in the middle third. None were at the junction between the middle and lower third as desired.
Conclusion: Usual landmarks and arm positioning during arthroscopic Latarjet may engender a high subscapularis split if it is performed from with a switching stick inserted through the posterior approach, passed across the glenohumeral joint at the level of the inferior glenoid. Additional measures must be taken to ensure correct level of the split using an inside-out technique.

FM99

Glenoid track and glenoid bone loss as a predictor of instability recurrence after Bankart repair: a 3D CT-scan study

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Introduction: High redislocation rates after Bankart repair are noted in patients with Hill-Sachs lesions, with even higher failure rates if a glenoid defect is also present (i.e. bipolar bone loss). Treatment algorithms have been proposed using the glenoid track concept and glenoid bone loss as a guide for decision making. Yet, consensus on what concept has the highest predictive value is still lacking. The aim of this study was to evaluate the glenoid track and glenoid bone loss as risk factors for recurrent instability after arthroscopic Bankart repair in patients with Hill-Sachs lesions.
Methods: Patients that underwent an isolated arthroscopic anterior Bankart repair between 2008 and 2016 were retrospectively reviewed. Inclusion criteria were ≥18 years of age; traumatic, recurrent, anterior shoulder instability; a visible Hill-Sachs lesion on the preoperative CT-scan; and a minimum 2-year follow-up with exclusion of earlier recurrence. Patients that had a concomitant lesion, instability secondary to seizures, hyperlaxity or a CT-scan of poor quality were excluded. The glenoid track and glenoid bone loss were assessed on 3D CT reconstructions. Grouping variables determined by on-/off-track and bone loss percentages (20%, 13.5% and 10%) were evaluated in relation to instability recurrence using the positive predictive value (PPV), relative risk (RR) and odds ratio (OR).
Results: Out of 244 patients, 40 subjects (mean age 26 years; 7 female; 17 right shoulders) were included in this study. Instability reoccurred in 28 cases, within an average of 21 months. Twelve shoulders remained stable at a mean follow-up of 37 months. Grouping variables had a similar PPV, with ≥10% bone loss being the lowest (74%) compared to off-track lesions (80%), ≥20% (80%) and ≥13.5% (81%) glenoid bone loss. Off-track lesions had the highest RR (2) and OR (6.06) compared to glenoid bone loss of ≥20% (RR = 1.2; OR = 2), ≥13.5% (RR = 1.4; OR = 3.09), and ≥10% (RR = 1.2; OR = 1.79).
Conclusion: The glenoid track concept is a better indicator of recurrent instability after Bankart repair in patients with Hill-Sachs lesions than glenoid bone loss, when assessed on 3D CT reconstructions. Patients that had an off-track lesion had 2 times more risk of recurrence than on-track lesions.

FM100

Effect of capsule repair on rotational and varus stability in PLRI reconstruction

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Introduction: Insufficiency of the lateral collateral ligamentous complex causes posterolateral rotatory instability (PLRI). During reconstruction surgery the joint capsule is repaired, but its biomechanical influence on elbow stability has not been described. We hypothesized that capsular repair reduces ROM and varus angle after reconstruction of the lateral collateral complex.
Methods: Six fresh frozen cadaveric elbow specimens were used. Varus laxity in supination, pronation and neutral forearm rotation with 1 Nm load and forearm rotaitonal range of motion (ROM) with 0.3 Nm torque were measured using a Microscribe 3DLX digitizing system (Revware Inc, Raleigh, NC). Each specimen was tested under four different conditions: Intact, Complete Tear with LUCL, RCL and capsule tear, LUCL/RCL reconstruction + capsule repair and LUCL/RCL reconstruction only. Reconstruction was performed according to the docking technique (Jones, JSES, 2013) and the capsule was repaired with mattress sutures. Each condition was tested in 30°, 60° and 90° elbow flexion. A two-way ANOVA with Tukey's post-hoc test was used to detect statistical differences between the conditions.
Results: Total ROM of the forearm significantly increased in all flexion angles from intact to Complete tear ($p < 0.001$). ROM was restored to normal in 30° and 60° elbow flexion in both reconstruction conditions ($p > 0.05$). LUCL/RCL Reconstruction + capsule repair in 90° elbow flexion was associated with a significantly lower ROM compared to intact ($p = 0.0003$) and reconstruction without capsule repair ($p = 0.015$). Varus angle increased significantly from intact to complete tear ($p < 0.0001$) and restored to normal in both reconstruction conditions ($p > 0.05$) in 30° and 60° elbow flexion. In contrast varus angle was significantly lower in 90° elbow flexion in both reconstruction conditions compared to intact (both $p < 0.0001$).
Conclusions: Reconstruction of the lateral collateral complex restores elbow stability, ROM and varus laxity independent of capsular repair. Overtightening of the elbow joint occurred in 90° elbow flexion, which was aggravated by capsular repair. This overtightening causes stress to the transplant and might cause failure of the reconstruction. Therefore to avoid recurrence of PLRI, postoperative rehabilitation should avoid high degrees of elbow flexion to protect the reconstruction from wearing out.

***FM101**

Longitudinal observational study of delta III reverse total shoulder arthroplasty for irreparable rotator cuff dysfunction: results after 15 years

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Introduction: Whether long-term functional improvement with reverse total shoulder arthroplasty (RTSA) in patients with a dysfunctional shoulder due to an irreparable rotator cuff tear persists is under debate. It was the purpose of this study to analyze outcome of Delta III RTSA for massive, irreparable rotator cuff tearing beyond 15 years follow-up.
Methods: Twenty-two patients and shoulders with a mean age of 68 (range, 54–77) years at surgery were personally reviewed after a mean follow-up of 16.1 (range, 15–19) years. There were 15 patients (68%) with previous nonarthroplasty surgery. Patients were examined clinically and radiographically every 2 to 5 years until final follow-up.
Results: The mean absolute and relative Constant score (aCS; rCS) had improved from 24 (± 11) to 61 points (± 18; gain of 37 points; $p < 0.001$) and from 31% (± 13) to 75% (± 20; gain of 44%; $p < 0.001$). Significant improvements were seen in mean pain scores (4 to 13 (out of 15) points; $p < 0.001$), active anterior elevation (53° to 104°; $p = 0.002$), abduction (55° to 87°; $p = 0.009$) and SSV (29% to 79%; $p < 0.001$). Mean rCS and SSV did not significantly deteriorate over 15 years and clinical results of patients with previous surgeries were not significantly inferior compared with patients with primary RTSA. One or more complications were recorded in 13 patients (59%), with six failed RTSAs (27%). Mean rCS of patients with complications (failures excluded) was not significantly inferior compared with patients without any complications (64% vs. 81%; $p = 0.142$).
Conclusion: Although the results after 15 years demonstrate a substantial complication and failure rate, Delta III RTSA for a

dysfunctional shoulder due to irreparable rotator cuff tearing yields substantial improvement in shoulder function and subjective outcome independent whether revision or primary RTSA was performed. There was no clinical deterioration beyond 15 years follow-up. In case of postoperative complications managed without removal, final functional outcome was not significantly inferior compared with patients without any complications.

FM102

Anatomic shoulder arthroplasty in elderly patients

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Anatomic total shoulder arthroplasty (TSA) has traditionally reported good results in the treatment of primary osteoarthritis. It is unknown whether these results are also present in patients over 8o years old when compared to a younger cohort. We retrospective report the results of patients over the age of 80 after anatomic TSA performed for primary osteoarthritis with a preoperative intact rotator cuff (Group I, n = 32)compared with a second group of patients under the age of 70 (Group II, n = 32). Subjective outcome, Constant score, and radiological findings were analysed. Sample size for a power of 80% is 22 patient for each group. The mean follow-up of was 81 months. In Group I, 75% of patients were very satisfied and 72% in Group II (p >0.5); the Subjective Shoulder Value was 81% in both groups (p >0.5). Radiological upper migration of the humeral head was detected in one patient in Group I and in 3 patients in Group II. Constant score was 65 in Group I and 67 in Group II (p >0.5). Results of Constant score in the older group were good or excellent in 69% of the patients, and in 63% in the younger group (p >0.5). One patient in Group II was revised for glenoid loosening. We found that excellent results can be expected when anatomic TSA is performed in patients over the age of 80 with a preoperative intact rotator cuff. To our knowledge, this is the first study to compare outcomes of anatomic TSA in 2 distinct age groups, with one of the groups being patients over the age of 80. Our findings suggest that age itself should not be considered a reason to implant a reverse instead of an anatomic TSA. Limitations of the present study include the retrospective design and therefore the inherent risk of selection bias. In summary, good to excellent results can be expected after anatomic TSA in patients over the age of 80 with an intact preoperative rotator cuff.

FM103

10 years' experience with a local shoulder arthroplasty register– an additional benefit?

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Introduction: Large arthroplasty registers allow investigations of short to long-term outcome using predetermined quality parameters and the recognition of potential advancements for patient care, notably by the early detection of emerging problems. In 2006 a local shoulder arthroplasty register was introduced in our clinic to comprehensively document all patients with shoulder arthroplasty surgeries. The aim of this work is to present our experience from the first 10 years.
Methods: Since 2006 all surgeries with implantation or revision of a shoulder prosthesis were included in the register, organized by the internal research team. The completeness rate of the registration was validated by comparison with data from the hospital information system. The baseline documentation and the regular postoperative controls (after ½, 1, 2, 5 years and then all further 5 years) include clinical examinations, imaging evaluation and a patient-based questionnaire set. Revisions and their causes were recorded for the computation of implant survival rates.
Results: A total of 2247 consecutive shoulder arthroplasties were documented. The preoperative documentation rate reaches 98% and thereby excels the internationally approved recommendations (>90%). The 5-years follow-up rate reaches 65% and is particularly affected by deceased patients (10%) and missing compliance (14%). So far 4% of the 2009 primary arthroplasties had to be revised. An anatomic shoulder prosthesis system attracted attention with a high revision rate of more than 20%, which led to an early implantation stop. The data are used for the internal quality assurance as well as increasingly for scientific publications and congress presentations (n = 3 resp. n = 8 in 2016).
Conclusions: 10 years since the implementation the clinic can rely on a functional arthroplasty register, which serves as a tool for continuous surveillance and quality control but also allows assessments for clinically relevant research questions. The goal for the future is harmonization of the documentation for potential collaborations with national and international shoulder arthroplasty registers.

FM104

Bony increased-offset reverse shoulder arthroplasty improve active forward flexion, not active rotations

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Objective: To evaluate the clinical functional outcomes of patients received standard reverse shoul-der arthroplasty (RSA) compared with those received bony increased-offset RSA (BIO-RSA). We hypothesized that the BIO-RSA cohort would have lower notching rates and improved range of motion (ROM).
Methods: Sixty-nine standard RSA and 61 BIO-RSA performed by a single surgeon were included into this retrospective comparative cohort study. At a minimum of 2 years' follow-up, outcomes included ROM and Constant score. Radiographs were obtained for all patients and examined for scapular notching, bony scapular spur, forming ossifications and healing of the graft.
Results: The demographic data was not significantly different between the standard group and BIO-RSA group. At final follow-up, patients with BIO-RSA group indicated significantly better anterior forward flexion (AFF) than standard group (145.2 ± 20.5 degrees and 137.5 ± 20.2 degrees, P = .017, respectively). There was no significant difference of external or internal rotation between the 2 groups. Patients with BIO-RSA group had significantly higher Constant score than standard group (69.0 ± 9.4 and 61.4 ± 12.7, P < .01X, respectively). Evaluation with plain radiographs indicated no significant difference between the two groups.
Conclusion: RSA significantly improved postoperative ROM and Constant score. Patients with BIO-RSA compare to standard group had better results in AFF and Constant score, but not in rota-tion. Results emerging from a compromise between glenoid and humeral lateralization have to be evaluated in future studies.

***FM105**

Two year comparison of clinical and graft outcomes in patients undergoing tibiofemoral or patellofemoral matrix-induced autologous chondrocyte implantation (MACI)

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Background: Matrix-induced autologous chondrocyte implantation (MACI) has demonstrated encouraging clinical results in the treatment of knee chondral defects. However, earlier studies suggested that patellofemoral (PF) MACI is less effective than tibiofemoral (TF) MACI. It was the purpose of this study to compare the radiological and clinical outcome of those undergoing MACI to either the femoral condyles or PF joint.
Methods: A total of 194 patients were included in this analysis, including 127 undergoing MACI to the medial (n = 94) and lateral (n = 33) femoral condyle, and 67 to the patella (n = 35) or trochlea (n = 32). All patients were evaluated clinically (KOOS, VAS, SF-36) pre-surgery and at 3, 12 and 24 months' post-surgery, while magnetic resonance imaging (MRI) was undertaken to evaluate the quality and quantity of repair tissue, as well as an MRI composite score, at 3, 12 and 24 months. Patient satisfaction was evaluated.
Results: No significant group differences (p >0.05) were seen in demographics, defect size, prior injury or surgical history, while the majority of clinical scores were similar pre-operatively. A significant time effect (p <0.05) existed for all scores over time, with a significant group effect observed for KOOS activities of daily living (p = 0.008), quality of life (p = 0.008) and sport (p = 0.017), reflecting better post-operative scores in the TF group. At 24 months, 93.7% (n = 119) and 91.0% (n = 61) of patients were satisfied with the ability of MACI to relieve their knee pain, 74.0% (n = 94) and 65.7% (n = 44) with their ability to participate in sport, and 90.5% (n = 115) and 83.6% (n = 56) were satisfied overall, in the TF and PF groups, respectively. MRI revealed a significant time effect (p <0.05) for the MRI composite score and graft infill over the 24-month period. While subchondral lamina scored significantly better (p = 0.002) in the TF group, subchondral bone scored significantly worse (p <0.0001). At 24 months, the overall MRI composite score was classified as Good-Excellent in 98 TF patients (77%) and 54 PF patients (81%).
Conclusion: MACI in the PF joint with concurrent correction of PF maltracking if required leads to similar clinical and radiological outcomes, compared to MACI on the femoral condyles.

*FM106

Spatial variations in cartilage thickness and bone mineral density are correlated in non-osteoarthritic knees but not in osteoarthritic knees

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Introduction: There is a critical need to improve therapeutic options for knee osteoarthritis (OA), especially in the early stages of the disease. Knee OA is a complex pathology affecting several elements of the joint, including its structure, biology and function. Recent research has suggested a shift in the modeling of the disease, with a focus on the relationships between knee components rather than on isolated components. This newly proposed OA model particularly suggests that knee components are adapted to each other in non-OA knees, thus maintaining homeostasis. Next, when one or several components change, for example after a trauma, the other components might be unable to adapt to the change thus disturbing homeostasis and leading to joint degradation. Since improving treatment requires better understanding of OA pathogenesis, there is an interest in assessing and further developing this new OA model. Cartilage thickness (CTh) and subchondral bone mineral density (sBMD) have been well described with knee OA, however there is little data regarding their relationships. This study aimed to quantify the spatial variations in CTh and sBMD and test for relationships in non-OA and OA knees.
Methods: CT-arthography images of 16 non-OA knees and 16 knees with severe medial OA (KL grade ≥3), matched for age (61.2 ± 4 years old), gender (50% male) and morphometric parameters, were processed using custom software to calculate anatomically-standardized maps describing the variations in CTh and sBMD along the tibiofemoral articular surfaces. Pearson correlations between the pixels of the CTh and sBMD maps were calculated for each articular surface of each knee.
Results: The spatial variations in CTh and sBMD were correlated in non-OA tibias ($R = 0.60 \pm 0.12$) and femurs ($R = 0.58 \pm 0.10$). The positive correlation coefficients ($p < 0.0001$) indicated that cartilage was thicker where bone was denser and vice versa. Correlations coefficients were significantly lower ($p < 0.0001$) in OA tibias ($R = 0.05 \pm 0.27$) and femurs (-0.08 ± 0.34), with inconsistent positive/negative correlations among knees.
Conclusion: The results supported the OA model. The positive correlations in non-OA knees could be related to mechanical loading, where higher local stresses induce both thicker cartilage and denser bone. The absence of correlation in OA knees suggested that CTh and sBMD were not adapted in those knees. Further studies with varying severities of knee OA are needed.

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*FM107

The anatomy of the articularis genus muscle and its function as part of the extensor apparatus of the knee joint

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Introduction: The anatomy of the articularis genus (AG) muscle has prompted speculation that it elevates the suprapatellar bursa during extension of the knee joint and prevents impingement of the synovial membrane between the patella and the femur. However, architectural parameters of the AG such as the cross-sectional area and the pennation angle indicate that it is not capable of generating enough force to fulfil this function. The purpose of this study was to further investigate the anatomy of the AG with special emphasis on its interaction with the adjacent muscles, vastus intermedius and vastus medialis.
Methods: The AG muscle was investigated in eighteen human cadaveric lower limbs. The mode of origin and insertion of the AG, its nerve supply and specifically its connections with the vastus intermedius and medialis was studied.
Results: The muscle bundles of the AG were organized into three main layers. The superficial layer and 60% (10/18) of the intermediate layer originated from both the vastus intermedius and the anterior surface of the femur. The deep bundles and 40% (8/18) of the bundles of the intermediate layer arose solely from the front of the femur. Distal insertion sites included different levels of the suprapatellar bursa and the joint capsule. A number of connections between the AG and the vastus intermedius were found. While the vastus medialis inserted into the whole length of the VI aponeurosis it included muscle fibres of the AG building an intricate muscle system supplied by nerve branches of the same medial deep division of the femoral nerve.
Conclusions: With support of the vastus intermedius and vastus medialis the AG, albeit consisting of very small muscle bundles, is capable to fulfil its function as a retractor of the suprapatellar bursa. The interplay between the AG, the vastus intermedius and vastus medialis is supported by their concurrent innervation. Given its relationship to the anterior aspect of the knee joint and its association with the vastus intermedius and medialis deterioration of the AG may lead to a malfunction of the extensor apparatus of the knee joint. Dysfunction, scaring or postoperative arthrofibrosis of this sophisticated interactive mechanism could have functional implications.

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*FM108

Ambulatory knee mechanics varies with lateral wedge length

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Introduction: The peak (pKAM) and impulse (iKAM) of knee adduction moment during walking have been related to progression and pain in medial knee osteoarthritis (OA), motivating interventions to reduce these variables. Lateral wedges (LW) could be a great asset to achieve these gait changes. However, LW literature is inconsistent, which limits the uses of these devices. There is a possibility that the inconsistencies are related to variations in LW design. This study aimed to determine the effects of LW length on the pKAM and iKAM.
Method: Standard camera-based gait analysis was performed on 12 healthy subjects (5 male; 24 ± 3 years old; 23 ± 3 kg/m^2). pKAM and iKAM were measured for 4 LW lengths: no LW (N); LW under the calcaneus (C); LW running under the calcaneus to the metatarsal heads (M); and LW under the entire foot (F). Repeated ANOVA tests were performed to determine whether LW length (N, C, M and F) had an effect on the KAM. When necessary, post hoc t-tests were done to compare KAM variables among LW lengths. Statistical significance was set at 5%, with Bonferroni correction.
Results: The length of the LW had significant effects on the pKAM ($p = 0.035$) and iKAM ($p = 0.015$). Walking with LW of lengths M and F significantly decreased the pKAM by 0.35 ± 0.42 %BW*Ht ($p = 0.015$) and 0.31 ± 0.29 %BW*Ht ($p = 0.004$), respectively, compared to walking without LW (N). pKAM reductions did not differ between LW of lengths M and F ($p = 0.55$). iKAM decreased with all LW lengths compared to no LW ($p < 0.002$); reductions were 0.08 ± 0.07, 0.16 ± 0.12 and 0.15 ± 0.12 %BW*Ht*s for the C, M and F lengths, respectively. iKAM reductions with LW of lengths M and F were not different ($p = 0.81$), but were larger than the reductions with LW of length C ($p < 0.006$).
Conclusion: Both KAM variables were influenced by the length of the LW. Since LW length was generally overlooked in prior research, it is possible that the variations in KAM reductions and clinical improvements among past studies are related to undocumented variations in LW length. The length factor should be considered in future research. The results indicated that LW should run at least under the calcaneus to metatarsal heads to decrease the pKAM and iKAM; extending the LW to the entire foot did not induce additional KAM reductions. This finding is important as it suggested that no LW is necessary under the toes, which could improve comfort and compliance. Further studies are needed to confirm these results in OA patients.

FM109

The role of ipsilateral iliac crest autograft in medial opening-wedge high tibial osteotomy – a prospective randomized controlled trial

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Introduction: Medial opening-wedge high tibial osteotomy (mHTO) is a valuable surgical technique in medial osteoarthritis and varus knees. Supporting material such as iliac crest autograft (ICA) is thought to promote healing of the osteotomy and to prevent loss of correction. So far, no randomized controlled trial has been performed.
Methods: Between 2005 and 2009, patients undergoing mHTO stabilized by a medial locking compression plate, that matched the inclusion criteria (between 18 and 60 years with isolated medial gonarthrosis) and exclusion criteria (infection, previous surgery on the iliac crest, rheumatoid arthritis or other inflammatory diseases of the joints, varus malalignment >20° and flexion contracture >20°), were randomized in a group with ICA and a control group. Patient's

demographics, pre- and postoperative leg axis, healing of the osteotomy measured on CT scan in percentages at 3 and 12 months postoperatively and functional scores (Knee Society Score (KSS) and WOMAC score) were recorded.
Results: 40 patients were included wherefrom 15 knees were randomized in the ICA group, and 25 knees in the control group. The groups were comparable in terms of age (42.3 vs 43.3 years), gender distribution (7 out of 15 vs. 17 out of 25 male), BMI (30.2 vs. 29.2 kg/m^2), active smoker (6 out of 15 vs. 8 out of 25) and partial medial meniscectomy (3 out of 15 vs. 6 out of 25). Pre-operative varus (6.9° in ICA vs. 7.6°) and post-operative valgus (2.2° vs. 3.0°) were similar. Increased osseous gap healing was found after 12 and 52 weeks in the ICA group (40.1% vs. 10.8% p ≤0.045 and 91.5% vs. 59.1% p ≤0.001). A multiple linear regression analysis for healing of the osteotomy found that bone grafting was a promoting and increased pre-operative varus a retardant independent factor at 12 weeks (p ≤0.004 and p ≤0.002) and 52 weeks (p ≤0.001 and p ≤0.003), whereas age as promoting factor only at 12 weeks (p ≤0.001). No correlation was found between bone healing of the osteotomy and any functional outcome parameter, BMI, history of smoking or previous meniscal surgery.
Conclusion: ICA significantly increases healing of the osteotomy after mHTO at 12 and 52 weeks. Pre-operative varus and age of the patient are other independent factors that influence bone healing. No improvement of ICA in terms of functional outcomes could be found at 12 or 52 weeks postoperatively. Hence routine use of ICA cannot be recommended.

FM110

Does valgus high tibial osteotomy influence ankle and hindfoot alignment?

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Introduction: High Tibial Osteotomy (HTO) is a well established treatment performed for the treatment of unicompartmental osteoarthritis of the varus knee. The impact of this procedure on the alignment of the knee is well documented, but there is scarce literature on its effects on the ankle and hindfoot. The purpose of the present study is to analyze the influence of HTO on the alignment of the ankle and hindfoot.
Methods: 15 patients (mean age 39.6 ± 10.0 years) who were scheduled to undergo an open wedge valgus HTO in our institution were included. Pre and postoperative full weight bearing xrays were prospectively collected, including hip-to-ankle long standing, hindfoot and ankle views. Following measurement were performed: the talar tilt (TT), the tibial inclination (TI), the lateral angle between tibial mechanical axis and talar surface (LTTA), and the Hindfoot alignement which was determined by the angulation between the anatomical axis of the tibia and the axis of the calcaneum. Knee alignment was measured by hip-knee-ankle angle (HKAA) and percentage of the tibial plateau width at the intercept with load bearing axis (ILBA). Comparison of pre and post operative variables was determined using the Wilcoxon signed-rank test while the strength of the association between these parameters was measured with a Spearman's correlation analysis.
Results: After HTO, HKAA changed from 174.3 ± 2.5° to 181.3 ± 1.8° (p <0.05), lateralising the weight bearing axis. Indeed, the pre and post operative ILBA was located at 24.0 ± 10.5% and 55.1 ± 9.4% respectively (p <0.05). At the ankle level, HTO modified the LTTA from 88.8 ± 2.8 ° preoperatively to 86.2 ± 4.3° post-operatively (p <0.05). It also decreased the TI from 3.7 ± 2.3° laterally to 1.8 ± 2.9° medially (p <0.05) and changed the TT from a varus of 2.1 ± 3.8° to a valgus of 5.5 ± 4.4°(p <0.05). Hindfoot alignment has also been modified by the HTO reducing the pronation from 4.4 ± 6.2° to 1.9 ± 6.9° (p = 0.08). Using a linear regression, we did not find any correlation between the degree of HKAA correction and any of the aforementioned parameters except for the TI (correlation coefficient = 0.60, p <0.05).
Conclusion: Medial open wedge HTO modifies ankle and hindfoot alignment. However, no correlation could be found between the variation of mechanical axis and hindfoot/ankle angles except for tibial inclination.

FM111

Changes in gait pattern in adolescents with recurrent patellar instability

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Purpose: To evaluate the kinematics of the ankle, knee, hip and pelvis in the sagittal plane in adolescents with recurrent patellar dislocation in comparison to a matched, healthy control group.
Methods: 88 knees (67 patients) with recurrent patellar dislocation (mean age 14.8 y ± 2.8 SD) were compared to 54 healthy knees (27 individuals, 14.9y ± 2.4 SD), matched for age, sex, BMI. Kinematics of ankle, knee, hip and pelvis were captured using 3D-gait analysis (VICON, Plug-in-Gait). One cycle (100%) consisted of 51 data-points. The mean of six trials was computed. Temporospatial variables were assessed. Durations and kinematics of the stance-phase, loading-response, mid-stance-phase, preswing, and swing-phase were calculated.
Results: Only walking speed (-6.7%) decreased as a temporospatial variable. The loading-response increased 0.02s ± 0.01SE (10.8%) with dislocations (0.98% of total gait, P <0.01). The mid-stance-phase decreased equally (P <0.01). Dislocation decreased knee flexion during the entire gait cycle (P <0.01), with the minimal peak during mid-stance (9.01° ± 7.23 SD vs. 18.54° ± 6.72 SD). Dislocation increased plantar-flexion during loading-response 4.10° ± 0.43 SE (P <0.01), afterward, the dorsal-extension decreased 3.19° ± 0.30 SE, (P <0.01). Dislocation decreased hip flexion during all phases (P<0.01), maximal different during mid-stance with 7.46° ± 0.53 SE. 80% of all patients developed this gait pattern. Correlations between the knee flexion and either plantar-flexion and hip flexion were strong with r = 0.75 and r = 0.61 (P <0.01), respectively.
Conclusion: Recurrent patellar dislocations decrease the knee flexion during the loading-response and the mid-stance phase. A decreased hip flexion and increased plantar-flexion indicate a possible compensation mechanism.

FM112

A comparison of intra-operative palpatory and radiographic landmarks of the femoral insertion of the MPFL in trochlear dysplastic knees and controls

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Introduction: Positioning of the femoral tunnel in medial patellofemoral ligament (MPFL) reconstruction is essential not only in terms of stability, but also for restoring patellar tracking and contact pressures. So far anatomical and radiographic landmarks of the femoral MPFL insertion site have mainly been described in non-dysplastic knees. The aim of this study is to compare the intra-operative palpatory and radiographic landmarks used during MPFL-reconstruction in function of trochlear dysplasia.
Methods: 70 knees with trochlear dysplasia which underwent CT-scan are included in this study, wherefrom 36 with trochlear dysplasia type A and B (group AB), and 34 knees with hypoplasia of the medial femoral condyle (hence type C and D trochlear dysplasia, group CD). The antero-posterior height (hMFC) and the medio-lateral size of the medial femoral condyle, and the height of the medial femoral epicondyle (hMFE) are analysed. The adductor tubercle was visualised on 3D CT osseous surface reconstructions, and the femoral MPFL insertion site was placed 10.6 mm more distally (pMPFL) according to Fujino. This point was then compared to the Schöttle point (rMPFL) measured on true lateral translucent 3D-CT images. A gender and aged-matched group without trochlear dysplasia undergoing CT scans for tibial plateau fracture were used as controls (group ctrl).
Results: The variance of pMPFL/rMPFL significantly increases from group ctrl to group AB and CD (linearity p <0.001). The rMPFL lies more proximal, hence closer to the adductor tubercle and varies especially more in the horizontal plane with increasing trochlear dysplasia. The hMFE is found more ventrally in the dysplastic group, progressively increasing with trochlear dysplasia (linearity p <0.001) which correlates with a more proximal rMPFL (p <0.01). The medial femoral condyle is significantly wider (18%, linearity p <0.001) with progressing trochlear dysplasia, showing no association to the variance of pMPFL/rMPFL.

Conclusions: The rMPFL (or Schöttle point) shows significantly higher variations to the intra-operative palpatory landmarks especially in the horizontal plane in function of dysplastic medial femoral condyle. Therefore the type of trochlear dysplasia might bias the intra-operative landmarks used for MPFL reconstruction, and a probably a combination of surface anatomy and radiographic landmarks should be used.

FM113

A simple kneeling system for accurate posterior drawer stress radiographs

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Introduction: Stress radiography is superior to clinical evaluation for the accurate evaluation of posterior cruciate ligament (PCL) insufficiency. The amount of posterior drawer (PD) used in decision making for treatment are referred to Telos stress radiography system. Despite the fact that the device has shown accuracy and reproducibility, its clinical use remains technically challenging, creates pain and is time consuming. Kneeling views have been proposed as an alternative but failed to show similar precision due to unreliable patient positioning.
Purpose: to evaluate the accuracy and reliability of a new self-designed kneeling system for posterior drawer radiographs.
Methods: A kneeling box was designed to allow simple and reproducible patient and x-ray cassette positioning. The box is only supporting the lower leg up to the tibial tubercle, with the patella and femoral condyle unsupported. A slot allows the cassette to be placed perpendicularly between patient's legs. Twenty seven patients presenting a PCL injury were included in our study. For each patient, PD radiographs of both knees were performed using both our kneeling system (KS) and the Telos device (TD). Posterior tibial translation was measured on each radiograph by four independent observers, according to bony landmarks described by Jacobsen and Staubli. The result was expressed as the side to side difference (SSPTT). Statistics included Wilcoxon's test to compare SSPTT measures, Spearman's rank test to correlate measures between both techniques, residuals evaluation after linear regression and intra class coefficient for inter observer reliability analysis.
Results: For all four observers, the SSPTT was not significantly different when measured using the TSD and KS. After linear regression between SPTT values measured with TD and the values predicted the KS device, residuals were similar between observers. Furthermore, intraclass correlation coefficient was high (>0.8). Correlation coefficient between KS and TD measurements varied from 0.82 (95% CI: 0.66–0.92) to 0.95 (95% CI: 0.89–0.98), depending on the observer.
Conclusion: A proper patient and x-ray cassette setting for kneeling views allows an accurate and reproducible measure of posterior drawer laxity. A simple self-designed kneeling system might offer an alternative to the technical challenges encountered in measures performed with the Telos device.

FM114

Does single injection or continuous femoral nerve block worsen quadriceps recovery after ACL reconstruction?

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Recent studies suggested that single injection (SI-FNB) or continuous nerve block (CO-FNB) affect femoral nerve and quadriceps function after anterior cruciate ligament reconstruction ACLR. As reduced quadriceps strength was identified as a risk factor for graft failure, the use of femoral nerve analgesia for postoperative pain management in ACLR has become as source of debates. Despite these prior reports, we have recently shown in a randomized controlled study that CO-FNB does not alter femoral nerve electrophysiological function.
Purpose: To evaluate quadriceps function after SI-FNB and CO-FNB in patients receiving ACLR with hamstring autograft.
Methods: Between April 2014 and December 2015, 171 patients underwent ACLR in our center by a single surgeon. Patients undergoing revision, multi ligament reconstruction and ACLR with quadriceps or patellar tendon autograft were excluded. 112 patients were included. Patient cohort was separated into a single femoral nerve block group (SI-FNB), a continuous nerve. Patients were prospectively followed with quadriceps isokinetic strength tests at 4 and 8 months postoperatively. Univariate analysis was performed for patient demographics and surgery variables. We used a chi² test for categorical data and an analysis of variance for continuous data by a Ficher test.
Results: Groups could be matched for age (28.3 ± 8.7 yo), gender (sex-ratio 1.60:1), side, BMI (24.0 ± 3.4 Kg/Sqm), and concomitant meniscal repair (25.9% of patients). 16 had SI-FNB (group SI-FNB), 64 CO-FNB (group CO-FNB), 32 no loco-regional anesthesia (group No-FNB). At 4 mouths, absolute values of slow concentric quadriceps activation for the operate side was 121 ± 58 Nm/kg for the group No-FNB, 135 ± 48 for the group CO-FNB and 107 ± 53 for the group SI-FNB without a difference between the groups (p = 0.13); For fast concentric quadriceps activation we found no difference between the groups (p = 0.09) ; For fast concentric quadriceps fatigability, no difference between the groups (p = 0.89). About excentric quadriceps activation we found a significant difference (p = 0.02) but comparing differences in Nm/kg between the healthy side and the operated side on excentric quadriceps activation in the 3 groups show no significant result with a p = 0.53, it can be explained by the difference of base strength between patients.
Conclusion: 4 mounth after ACL reconstruction, there is no difference in quadriceps strength, regarding the modality of locoregional anesthesia.

FM115

Patient satisfaction after anterior cruciate ligament reconstruction in outpatient surgery

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The anterior cruciate ligament (ACL) reconstruction is performed in Switzerland, almost exclusively in inpatient care setting. Some authors have published good results with high patient satisfaction performing ACL reconstruction ambulatory and reducing general costs. Aim of our study is to determine the patient satisfaction after outpatient ACL reconstruction. We retrospectively collected all our outpatient patients and identified the ACL reconstruction in our hospital between 2009–2012.General statistical data on patient age, gender, ASA classification were recorded. Patients were interviewed by phone about the satisfaction with the ambulatory management, about perioperative pain (Visual Analogue Scale, VAS) and sleep patterns during the first night. In this period, out of 92 patients operated for ACL surgery, 22 patients were identified as outpatient planned patients. 17/22 patients could be reached by phone. 3/17 patients could not be released at home after surgery because of not well controlled pain or nausea. Of the remaining 14 patients (all men, median age of 25.5 year). 50% of the patients would not perform the outcome setting again; 50% of the patients could sleep the first night, the other little or not at all. In the subgroup of the patients under 25 years (n = 7), 6 patients would not perform again outpatient setting and had a mean value of 6.5 on the VAS the first night. Only one was able to sleep through the night. Interestingly, in the subgroup over 26 years (n = 7), 6 would do the surgery again in an ambulatory care, mean value of VAS was 5.2, /7 could sleep during the night. In the majority of the patients in our study, pain was not sufficiently controlled during the first night and because of this most of the patients would not want to perform such surgery in outpatient setting. Only 7/17 patients would repeat the outpatient surgery and most of them were in the subgroup older than 26 years. This study demonstrates that we should increase our effort on post operative pain management, the factor that actually impede to have satisfactory outpatient ACL reconstruction surgery.

FM116

Integrated evaluation of muscle plasticity during a sixteen-year follow-up after open reconstruction of the anterior cruciate ligament

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Introduction: Reconstructive surgery and subsequent ambulant rehabilitation is the established procedure to re-instate stability of the knee joint after rupture of the anterior cruciate ligament (ACL). We monitored relationships between knee stability and reactions in knee extensor muscle during rehabilitation after reconstructive surgery of the ruptured anterior cruciate ligament (ACL).
Methods: 9 patients (29 years, 8 male, 1 female) with unilateral rupture of the ACL did undergo open reconstructive surgery followed

by mobilisation and daily resistive exercise between 9 and 26 weeks and subsequent home-based activity. Clinical assessments were carried out at time point (zero) of surgery, 52, 260 and 832 weeks to qualify knee joint arthritis and instability. Biopsies were collected at 9, 26 and 260 weeks from m. vastus lateralis (VL) and characterised for cellular and molecular indices of mechanical and metabolic muscle function. Effects were compared versus the 260 weeks' time point in the non-operated leg and assessed for linear relationships.
Results: Indices of knee instability in the operated leg after reconstructive surgery and rehabilitation were improved at week 52, 260 and 832 relative to the poor values at surgery, i.e. 7, 10 and 11 mm vs. 16 mm deflection in the drawer test. Average values for cellular indices of metabolic and mechanical function of VL were impaired at week 9 in both legs. This deficit was more pronounced in the operated leg (–31%, –11%) than non-operated leg (–22%, –10%), and remained unchanged until week 26. Molecular indices of mitochondrial respiration in VL did show a larger deterioration in the operated than the non-operated leg at week 9 and 26. Molecular and cellular Indices of muscle function, except the volume density of subsarcolemmal mitochondria (–31%) and complex IV (–54%), returned to normal levels at week 260. Indices of knee joint arthritis/instability at time zero correlated with indices of mechanical and metabolic muscle function at week 9 and 26.
Conclusion: Disuse subsequent to ACL rupture leads to the deterioration of muscle structure before load bearing physical activity resumes. Ambulant resistive exercise halts the structural and molecular degeneration of muscle and this effect is graded to clinical indices of knee joint integrity. Mechanical aspects of knee extension fully recovered 5 years after the rupture and reconstruction but recovery of local aerobic capacity was still incomplete.

FM117

The accessory iliotibal-band-meniscal ligament: prevalence and association with lateral meniscal tears

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Introduction: Meniscus lesions of the knee may lead to increased articular cartilage wear and pain. While the anchoring of the medial meniscus is consistent, fixation of the lateral meniscus is more variable, and studies describing variants of attachment are scarce. Based on the clinical impression, that a distinct fibrous connection between the anterolateral aspect of the lateral meniscus and the iliotibial band was commonly seen in patients with lesions of the lateral meniscus, we set out to investigate the prevalence of this structure and its association with lesions of the lateral meniscus. We hypothesized that an accessory iliotibial-band-meniscal ligament (AIML) would be consistently found on MRI, and that there would be an association between lesions of the lateral meniscus and the presence of an AIML.
Methods: Following ethics committee approval, we studied 1'019 consecutive MRI scans of the knee, performed at our institution between January 1st 2015 and August 31st 2016. All knee-MRI were evaluated for lesions of the lateral meniscus, presence of Hoffa edema as well as presence of an AIML. If present, morphometric parameters were assessed. General descriptive statistics were applied and univariate analyses were performed to assess the associations of the AIML and meniscal lesions and Hoffa edema.
Results: An (AIML) was found in 13.3% of the cases (n = 136/1'019). There was no difference in sex distribution (female n = 61 vs. male n = 75, p = 0.269). Mean length of the AIML was 22.8 mm (12.9–36.8 mm, SD 5.8 mm). A lesion of the anterior horn of the lateral meniscus was recorded in 1.3% of the cases without AIML (n = 11/883) and 23.5% in presence of an AIML (n = 32/136, p <0.001). A lesion of the body of the lateral meniscus was found in 1.6% of the cases without AIML (n = 14/883) and 16.2% in presence of an AIML (n = 22/136, p <0.001). Hoffa edema was seen in 0.2% (n = 2/883) without AIML and 14.0% in presence of an AIML (n = 19/136, p <0.001).
Conclusion: The accessory iliotibial-meniscal ligament seems to be an anatomical variant of fixation of the lateral meniscus. In our sample population, it was consistently detected and there was a highly significant association with both lesions of the lateral meniscus as well as Hoffa edema. Further studies are necessary to investigate the biomechanical importance of the AIML in order to assess future clinical implications such as resection of the AIML in select cases during arthroscopy.

FM118

Rotational and varus laxity in a cadaveric model of posterolateral rotatory instability

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Introduction: Posterolateral rotatory instability (PLRI) is the most common type of elbow instability. It is caused by an insufficiency of the lateral ligamentous complex, which consists mainly of the radial collateral ligament (RCL) and the lateral ulnar collateral ligament (LUCL). The objectives were to investigate the influence of serial sectioning of the lateral ligamentous complex on elbow stability in a cadaveric model of PLRI.
Methods: Kinematics of six fresh frozen cadaveric elbow specimens were measured by digitizing anatomical marks with a Microscribe 3DLX digitizing system (Revware Inc, Raleigh, NC). Each specimen was tested under four conditions: Intact, LUCL tear, LUCL and RCL tear, and complete Tear (LUCL, RCL and capsule tear). Each specimen was tested in 30°, 60° and 90° elbow flexion angles. Varus- laxity was measured in supination, pronation, and neutral forearm rotation positions and total forearm rotation was measured with 0.3 Nm of torque. Statistical significant differences between the conditions were detected using a two-way ANOVA with Tukey's post-hoc test.
Results: The radial head dislocated in all specimens in LUCL and RCL tear and Comp but not in LUCL tear. Total forearm ROM did not increase form intact to LUCL tear (p >0.05) but significantly increased in LUCL and RCL tear (p = 0.0002) and complete tear (p <0.0001) in all flexion angles. Additionally, ROM in LUCL tear significantly differed from LUCL and RCL tear and complete tear (p = 0.0027 and p = 0.0002). A similar trend was seen with the varus angle. While there was a significant difference when the intact condition was compared to both the LUCLand RCL tear and complete tear conditions (p <0.0001 and p <0.0001), there was no difference between the intact and LUCL tear conditions.
Conclusions: PLRI is a complex injury of the elbow so far defined as radial head dislocation and increase in varus laxity. In accordance with previous literature, LUCL tear alone is not sufficient to cause PLRI; additional RCL tear is needed to cause subluxation of the radial head and increase varus laxity. Capsular tear had no additional effect. Our study found that PLRI not only increases radial head dislocation and varus laxity but also leads to an increase in forearm ROM. The increase of forearm ROM is a so far unknown symptom in PLRI and might be used as an additional diagnostic feature in the clinical evaluation of the complex syndrome.

***FM119**

The interest of navigation for the treatment of pertrochanteric fractures with the gamma 3 nail

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Introduction: Per trochanteric fractures are frequent among the geriatric population and their number is increasing. Intra-medullary nailing of these fractures is a safe and reliable procedure, the main post-operative complication being the cut-out of the cervical screw through the femoral head estimated around 2% in previous studies. Baumgartner et al. previously demonstrated the relation between the odds of a cut-out and a Tip-Apex distance (TAD) >25 mm. The aim of our study was to evaluate the use of a navigation system (Adapt System, Stryker) in improving the TAD and subsequently reducing the rate of post-operative cut-out.
Methods: From May 2015 to April 2016, we included all the Swiss residents with a per trochanteric fracture who accepted to participate in this randomized, monocentric, prospective study. People were allocated in the conventional or "navigation" group with the help of dedicated software. The first group was operated with a standard fluoroscopy and the second one with the Stryker Adapt® System, also known as the FluoroMap®, allowing a 3D reconstruction of the proximal femur from the standard 2D images of the fluoroscopy. Patients were operated either by senior residents or head surgeons. The post-operative TAD was measured on the first radiographs, before patient's discharge. At 6 weeks, 3, 6 and 12 months and the TAD was measured independently by 2 different examiners on digital AP and axial radiographs.

Results: 75 Patients were included in the study (14 men and 61 women), and randomized in one of the two study groups. The groups were similar in age (83.4 vs 85.9 y.o), sex (82.5% vs 80% of women). The death ratio are similar (15% vs 14.3%). The TAD was measured at each endpoint on digital radiographs independently by two examiners. A significant difference was observed in favor of the FluoroMap® group with a mean TAD of 16.75 mm (95%CI: 15.33–18.17) versus 20.75 mm (95%CI: 19.36–22.15) in the standard group. 2 Cut-outs were observed in the standard group versus none with the FluoroMap but this was not statistically significant.
Conclusions: The use of the FluoroMap seems to help surgeons in achieving the best cervical screw placement.

FM120

Analysis of risk factors for failure of proximal femoral nailing (PFN-A) in intertrochanteric fractures

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Objective: The incidence of intertrochanteric fractures is increasing due to the world's aging population. Internal fixation by intramedullary nailing is commonly considered a safe and a reliable method to treat these fractures. However, postoperative varus displacement and consecutive cut-out are reported in 6.5–21.2% in literature and are associated with an increase of postoperative mortality and morbidity. The primary objective of this study was to analyse the number of complications after intramedullary nailing of intertrochanteric fractures with PFN-A and secondly to identify risk factors for secondary varus displacement.
Methods: Between January 2012 and January 2016, records of all patients suffering from an intertrochanteric fracture treated with PFN-A in our hospital (level 1 trauma centre) were reviewed. Only patients with strictly standardised pre-and postoperative radiographs were included and analysed concerning the following parameters: fracture classification, caput-collum-diaphyseal (CCD) angle, adequacy of reduction, blade position, tip-apex distance (TAD) and nail position in the femoral shaft. Minimum follow-up was at least three months.
Results: One hundred and one patients met the inclusion criteria of which 24 patients experienced complications. They are divided into non-implant related complications (33%) and implant-related complications (66.67%) such as cut-out (29.17%), nail breakage (4.17%) and tractus irritation symptoms (29.17%). Initial postoperative varus alignment, an improper location of the blade in the femoral head and a TAD greater than 25 mm were significant risk factors for postoperative varus collapse and cut-out. Additionally, we could show that an inadequate lateral offset of the nail in the ap x-ray is one of the major risk factors for further varus displacement.
Discussion: Two-thirds of complications following intramedullary nailing of intertrochanteric fractures are implant-related. In addition to already known risk factors for secondary varus displacement and cut-out, this study identified a lateralised nail entry which is increasing the lateral offset compared to the healthy hip as one of the major risk factors. Knowing about this factor and avoiding it by using a more medial entry point to prevent medialisation of the proximal fragment through the nail insertion may help to further decrease postoperative morbidity and mortality.

FM121

Direct anterior vs postero-lateral approach for bipolar hip hemiarthroplasty in femoral neck fractures: A prospective randomized study

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The aim of this prospective study is to compare two surgical approaches used for bipolar hip hemiarthroplasty (BHA) on elderly patients with femoral neck fractures with the primary endpoint of the early recovery. Our hypothesis was that the early recovery would be faster in the DA-group (direct anterior group). Based on a power analysis, one hundred patients aged 75 years or older were randomized to surgery using either a direct anterior (DA-group) or postero-lateral (PL-group) approach, and were followed up for 6 months. Surgical time, intra and postoperative complications were recorded for each patient. Pain and functional recovery with different scales (NRS, ADL, CAS) were evaluated at 3 days, 1, 3 and 6 months after surgery. Surgical time was slightly longer in the DA-group ($p < 0.0001$). There was no difference in both local and systemic complications between the two groups. Pain perception at three days and at one month after surgery was significantly higher in PL-group patients ($p < 0.0001$). Functional recovery was comparable in the two groups (at 3 days, 1 and 3 months after surgery). The main advantage of the direct anterior approach is the pain perception up to one month after the operation and therefore the possibility of a faster early functional recovery. The later recovery was as expected similar. Therefore, the anterior approach should be considered seriously for all patients with femoral neck fractures, taking into account the relative exclusion criteria for this approach (very short or varus femral neck, very muscular patient).

***FM122**

Femoral ostoechondroplasty can be performed without the risk of avascular necrosis in an experimental ovine FAI model

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Introduction: Studying the long-term effects of joint preserving surgery for FAI takes decades in human beings. To overcome this limitation, an experimental ovine FAI model was introduced, which has great potential to speed up research on FAI surgery through surgical FAI induction and subsequent offset correction. Anatomic studies showed that perfusion of the ovine femoral head is maintained by anterior and posterior retinacular vessels. Theoretically, the osteochondroplasty of the superior asphericity should not compromise the blood supply of the femoral head. However, the onset of avasulcar necrosis of the ovine femoral head has not been studied to date after femoral osteochondroplasty of the superior asphericity. Hence we assessed radiographs, MR images and histology sections for signs of avascular necrosis of the ovine femoral head after femoral osteochondroplasty.
Methods: This experimental controlled prospective study on 10 sheep (10 hips) was conducted after IRB approval. The sheep underwent surgical induction of FAI by unilateral varus intertrochanteric osteotomy. This varisation rotates the physiologic cam deformity which is located on the superior aspect of the ovine femoral head into the acetabulum and induces typical, focal chondrolabral damage as seen in patients with FAI. Correction of the deformity was performed via a gluteus split in 5 cases and via an anterior approach in the other 5 hips. Sheep were sacrificed after a further 140 days. One hour before sacrifice, sheep received i.v. gadolinium-DTPA and roamed free. Radiographs, and indirect MR arthrography (T1-weighted sequence with fat saturation, PD/T2-weighted without fat saturation) was performed and assessed for avascular necrosis of the femoral head using the Ficat and Arlet classification (0–4). Histologic samples were stained with toluidine blue and avascular necrosis was assessed according to the Catto criteria (necrotic bone trabeculae/ bone marrow, repair tissue).
Results: No evidence for avascular necrosis was found on radiographs, MR images (Ficat and Arlet Stage: 0) and histologic sections (Catto: no histologic signs of avascular necrosis) in all 10 hips.
Conclusion: The experimental ovine FAI model can be safely used to study the potential of joint preserving surgery for FAI to decelerate or even prevent development of osteoarthritis of the hip.

FM123

Ultrasonic cartilage thickness measurement is accurate, reproducible and reliable – validation using a novel micro-CT method

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Ultrasonography is a fast and patient-friendly modality to assess cartilage thickness. However, inconsistent results regarding accuracy have been reported. Therefore, we asked what is (1) the accuracy, (2) reproducibility, and (3) reliability of ultrasonographic cartilage thickness measurement using micro-CT as a novel validation method? A series of 50 cartilage-bone plugs were harvested from fresh bovine and porcine joints. Ultrasonic cartilage thickness was determined using an A-mode, 20 MHz hand-held ultrasonic probe with native (1580 m/s) and adjusted speed of sound (1696 m/s). All measurements were performed by two observers at two different occasions. Angle of

insonation was controlled by tilting the device and recording minimal thickness. Retrieval of exact location for measurement was facilitated by aligning the circular design of both cartilage-bone plug and ultrasonic device. Ground truth measurement was performed using micro-CT with iodine contrast-agent and a voxel size of 16 μm. The mean cartilage thickness was 1.383 ± 0.402 mm (range, 0.588–2.460 mm). Mean accuracy was 0.074 ± 0.061 mm (0.002–0.256 mm) for native and 0.093 ± 0.098 mm (0.000–0.401 mm) for adjusted speed of sound. Bland–Altman analysis showed no systematic error. A high correlation was found for native and adjusted speed of sound with CT (both r = 0.973; <0.001). A perfect agreement for reproducibility (intraclass correlation coefficient [ICC]s 0.992 and 0.994) and reliability (ICC 0.993, 95%-confidence interval 0.990–0.995) was found. Ultrasonic cartilage thickness measurement is accurate, reliable, and reproducible and its use can facilitate e.g. intraoperative decision making in joint preserving surgery.

***FM124**

Do dGEMRIC and T2 imaging correlate with histologic cartilage degeneration? An experimental ovine FAI model

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Introduction: dGEMRIC (delayed gadolinium enhanced MRI of cartilage) and T2 mapping are non-invasive MRI techniques increasingly used to judge cartilage quality in prearthritic conditions, such as femoroacetabular impingement (FAI). These techniques estimate distinct biochemical substrates of hyaline cartilage. In a clinical setting, the correlation between these techniques and histology is difficult and can be bypassed by using an animal model. Hence, we asked (1) whether dGEMRIC and T2 indices correlate with histological cartilage degeneration in a previously validated, experimental ovine FAI model and (2) whether there is a correlation between dGEMRIC and T2 imaging.
Methods: This experimental controlled prospective study on 5 sheep (10 hips) was conducted after IRB approval. Sheep underwent surgical induction of FAI by unilateral varus intertrochanteric osteotomy, which rotates the naturally aspherical ovine femoral head into the acetabulum, inducing typical focal chondrolabral damage as seen in patients with FAI. Correction of the deformity was performed after 70 days (FAI group). No surgery was performed in the 5 contralateral hips (Control group). Sheep were sacrificed after a further 140 days. One hour before sacrifice, sheep received i.v. gadolinium-DTPA and roamed free. Hips were dissected to fit into the coil. dGEMRIC and T2 maps were obtained at a 3 T unit (Philips Ingenia) using inversion recovery techniques. Histologic samples were stained with toluidine blue, and cartilage degeneration was graded with the Mankin score. Linear regression analysis was performed (p <0.05). (1) dGEMRIC and T2 times were measured with the help of radial images at the 12 acetabular and femoral clock-face positions and correlated to the Mankin scores. (2) dGEMRIC indices and T2 values were correlated with each other.
Results: (1) Overall and regional (up to R = –0.56; p = 0.046) inverse correlation was found between acetabular and femoral dGEMRIC indices and the Mankin score. No overall correlation was found between acetabular and femoral T2 indices and the Mankin score. (2) No significant overall correlation (p>0.05) between dGEMRIC indices and T2 values could be found.
Conclusion: These results support the continuing use of dGEMRIC for monitoring cartilage degeneration in FAI, both in a clinical and experimental setting to improve our understanding of osteoarthritis. The absent correlation between T2 imaging and dGEMRIC indicates complementary effects in cartilage.

***FM125**

Is acetabular labrum size and tear pattern associated with femoral retrotorsion or increased femoral torsion in patients with FAI?

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Purpose: Acetabular labrum size and labral tears antero-superior are typical for femoroacetabular Impingement (FAI). Femoral torsion (FT) is a novel cause for anterior FAI and influences labral size and tear pattern. Therefor we asked (1) what is the anterior labral size and (2) which labral tear patterns are associated with femoral retrotorsion compared to hips with elevated FT.
Methods and Materials: Out of 620 consecutive MR arthrographies we excluded 491 hips with normal FT. An IRB-approved retrospective radiological study involving 129 hips with symptomatic FAI and abnormal FT was performed. Femoral retrotorsion was defined as FT <5°(58 hips), elevated FT was defined as >30°(71 hips). All patients underwent routine radiological evaluation using MR arthrography (3T) including distal femoral condyles for calculation of FT. Labral size and labral tear patterns were measured circumferentially on every clock position (15° intervals) on radial slices trough the femoral neck.
Results: (1) Anterior labral size was significantly decreased in hips with femoral retrotorsion (14 mm^2 vs 22 mm^2, p <0.001) compared to posterior in hips with elevated FT. Labral size was significantly smaller anterior compared to posterior hips with femoral retrotorsion (p <0.001). (2) Labral tear patterns were more frequently anterior (2 and 3 o'clock, p <0.001) in hips with elevated FT.
Conclusion: Anterior labrum was smaller in hips with femoral retrotorsion on the corresponding localization of acetabular rim impingement. This has be considered during radiological diagnosis of FAI for hip preserving surgery. Anterior labral tear patterns could be associated with anterior subluxation or instability in hips with elevated FT.

***FM126**

Comparing dGEMRIC and clinical outcome 6 years after FAI surgery with versus without microfracturing: A prospective, controlled pilot study

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Introduction: Microfracturing is performed in advanced cartilage degeneration due to femoroacetabular impingement with the goal to induce cartilage repair tissue. It is unclear to which degree formation of cartilage repair tissue occurs in these patients. Delayed-gadolinium enhanced MRI of cartilage (dGEMRIC) is a novel, non-invasive, biochemical MRI technique that allows objective judgement of cartilage quality. Currently the correlation between mid-term clinical outcome and dGEMRIC after FAI surgery is not established. We aimed to compare: To compare (1) dGEMRIC indices, (2) clinical outcome in patients with a minimum 6-year follow up who had undergone FAI surgery with versus without microfracturing.
Methods: This prospective, controlled study was performed under IRB approval. The surgical hip database was reviewed for patients eligible for minimum 6-year follow up who underwent surgical hip dislocation with or without microfracturing for treatment of FAI and of extensive chondral flaps and defects. A total of 46 patients were identified, 17 in the "microfracturing group" and 29 in the "no microfracturing group". Groups were comparable for mean followup (mean 8 years; range 6–13 years) and age. All eligible patients underwent radiographs and dGMERIC at latest follow up. (1) dGEMRIC indices of acetabular cartilage were assessed on radially reformatted 3D T1 maps. Regions of interest were manually placed peripherally and centrally within the cartilage based on anatomical landmarks at the 12 'hour' positions of the clock-face. (2) Patient-reported outcome was evaluated at latest followup using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Harris Hip Score (HOOS). (3) Correlation between dGEMRIC and WOMAC and HOOS was performed using linear regression analysis.
Results: (1) Overall and regional (superior, anterior and posterior) dGEMRIC indices did not signifantly (all >0.05) differ between two groups. (2) WOMAC (52 ± 65 versus 39 ± 46; p >0.05) and HHS (71 ± 27 versus 87 ± 12; p >0.05) did not differ between the "microfracturing group" and "no microfracturing group".
Conclusion: These results either indicate the absence of cartilage repair tissue formation after microfracturing or some degree of repair tissue formation following FAI correction without microfracturing. Microfracturing did not improve clinical outcome hence future studies should compare microfracturing with more advanced repair techniques.

FM127

One out of six patients with FAI or hip dysplasia has femoral retrotorsion or elevated femoral antetorsion

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Introduction: Variations in both femoral torsion and acetabular version are becoming increasingly recognized as contributing factors to the development of hip pain in patients with femoroacetabular impingement (FAI) and hip dysplasia. It is still unknown what the true prevalence of these rotational abnormalities are in this patient population.
Goals: 1) The prevalence of femoral torsional abnormalities in symptomatic hips with FAI and dysplasia. 2) The prevalence of combined abnormalities of acetabular version and femoral torsion in these patients. 3) What subtypes of FAI and dysplasia are associated with torsional abnormalities of the femur.
Methods: A total of 462 symptomatic patients (538 hips) were included that presented with hip pain due to FAI or hip dysplasia at our tertiary referral center for hip preservation surgery between 2011 and 2015. We retrospectively compared femoral torsion and acetabular version among eleven subgroups with distinguished hip morphologies. The allocation to each subgroup was based on morphological reference values for femoral head coverage, LCE angle, alpha angle and the neck-shaft angle calculated on plain radiographs. These patients were also compared to a control group of 48 hips in asymptomatic patients. The Ward's method for hierarchical cluster analysis was applied to detect stereotypes of hip morphology related to femoral torsion.
Results: Of the 538 hips included, 52% were found to have abnormal femoral torsion, severe abnormalities were found in 17%. Severe Femoral retrotorsion (<0) was found in 5%, Moderate femoral Retrotorsion (0–10) was present in 17%, moderate femoral antetorsion (26–35) was present in 18%, and severe femoral antetorsion (>35°) was found in 12%. Furthermore, 68% of the hips presented with some combination of abnormal femoral torsion and acetabular version. The most frequent abnormal combination was an increased femoral torsion combined with a normal acetabular version (22%).
Conclusion: Abnormalities in femoral torsion are prevalent in 52% of patients with hip pain eligible for hip preservation surgery and severe abnormalities are prevalent in 17%. Based on these results, the evaluation of young patients with hip pain should always include an assessment of femoral torsion and acetabular version in order to best decide what treatment approach should be undertaken in order to optimize outcomes.

FM128

Do high impact sport promote proximal femoral pathomorphology before the growth spurt – preliminary results of a longitudinal, prospective, controlled study

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Introduction: Femoroacetabular impingement (FAI) is a leading cause for pain and early osteoarthritis in the young patient and can be differentiated in cam FAI and pincer FAI. Young men typically present with an aspherical extension of the epiphyseal scar which is referred to as "idiopathic" cam deformity. Preliminary studies have suggested that the alteration of the epiphyseal growth plate may be triggered by high-impact sporting activity (e.g. ice hockey, basketball). However longitudinal studies comparing development of femoral morphology in competitive athletes to a control group a currently lacking. The purpose of this study was to compare the proximal femoral anatomy before the beginning of the growth spurt of young boys playing ice hockey on a competitive level to a control group without the impact of competitive sport.
Methods: We report the preliminary results of a longitudinal, prospective, controlled study involving 25 boys (25 hips) at the age of 12 years playing ice hockey on the highest national level of their age to a age matched control group of 10 boys (10 hips) not competing in a sport activity. Extension of the study is planned for 3 years. All children underwent native MRI of the hip. We assessed the proximal femoral anatomy on radial proton density images around the "clock-face": epiphyseal angle, epiphyseal tilt angle, epiphyseal extension and alpha angle. Pairwise comparison was performed with independent t-tests for normally distributed data and with the Mann-Whitney U test nonnormally distributed data.
Results: We found comparable values for both groups for the epiphyseal angle (p-values: ranging from 0.072 to 0.857), epiphyseal extension (p-values: 0.209–0.836), and epiphyseal tilt angle (p-values: 0.142–0.970) circumferentially around the clock face. The ice hockey group showed decreased alpha angles at the anterior and anterior-superior portion of the femur (e.g. 3 o'clock position: 37.8° ± 2.4; control group: 45.1° ± 7.1; p-value: 0.010)
Conclusions: Before the growth spurt there is no evidence of an altered growth of the proximal femoral epiphysis. No abnormalities of the epiphyseal growth plate are present in skeletal immature athletes. These results suggest that the previously reported high incidence of idiopathic cam deformities develops during the growth spurt. However the planned followup is needed to confirm these preliminary results.

FM129

The Femoro-Epiphyseal Acetabular Roof (FEAR) index: A new measurement associated with instability in borderline hip dysplasia?

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Introduction: Definig osseous instability in borderline dysplastic hips is difficult. A reliable radiographic tool that might be associated with instability would be helpful for decision-making in this patient group. Goals of this study are: (1) To compare a new radiographic measurement, which we call the Femoro- Epiphyseal Acetabular Roof (FEAR) index, with the lateral center-edge angle (LCEA) and acetabular index (AI), with respect to intra- and interobserver reliability; (2) to correlate AI, neck-shaft angle, LCEA, iliocapsularis volume, femoral antetorsion and FEAR index with the surgical treatment received in stable and unstable borderline dysplastic hips; and (3) to assess whether the FEAR index is associated with clinical instability in borderline dysplastic hips.
Methods: The FEAR index was defined and validated in 10 standardized radiographs of asymptomatic controls using two blinded independent observers. Interrater and intrarater coefficients were calculated. Its reliability with LCEA and AI was compared. We performed a case-control study using standardized radiographs of 39 surgically treated symptomatic borderline dysplastic hips and 20 age-matched controls with asymptomatic hips. Treatment received was either a periacetabular osteotomy (for unstable hips) or, for patients with femoroacetabular impingement, either an open or arthroscopic femoroacetabular impingement procedure. The association of received treatment categories with the variables AI, neck-shaft angle, LCEA, iliocapsularis volume, femoral antetorsion, and FEAR index were evaluated. Sensitivity, specificity, and receiver operator curves were calculated. The primary endpoint was the association between the FEAR index and instability, which was evaluated on conventional radiographs and MR arthrography.
Results: The FEAR index showed excellent intra- and interobserver reliability, superior to the AI and LCEA. FEAR index was lower in the stable borderline group (mean, –2.1 ± 8.4) compared with the unstable borderline group (mean, 13.3 ± 15.2) (p <0.001) and had the highest association with treatment received. A FEAR index less than 5° had a 79% probability of correctly assigning hips as stable or unstable (sensitivity 78%; specificity 80%).
Conclusion: A painful hip with a LCEA of 25° or less and FEAR index less than 5° is likely to be stable. In such a situation, the diagnostic focus might more productively be directed toward FAI as a potential cause of pain, rather than instability.

FM130

Subtrochanteric rotational osteotomy for young adults with hip pain due to femoral maltorsion

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Introduction: Femoral maltorsion might be the origin of hip pain due to either pincer-like impingement in case of femoral retrotorsion or an overload of the acetabular rim in presence of excessive antetorsion. Femoral rotational osteotomies can be a treatment option in these situations. The aim of the present investigation was to document outcome and potential adverse effects, especially on the patellofemoral joint, in patient undergoing femoral rotational osteotomies.
Methods: Retrospective consecutive series of patients undergoing subtrochanteric rotational osteotomy between May 2011 and March

2015. Patients with previous hip surgery as well as patients with additional osteotomies on femur and/or pelvis were excluded. HHS, WOMAC, and Subjective Hip value preoperative and at last follow-up as well as subjective and clinical patellofemoral instability at last follow-up were outcome parameters. Additionally, femoral torsion pre- and postoperative as well as morphological signs of patella maltracking (TAGT, patellar tilt and lateralization) were measured on MRI and compared to the opposite side.
Results: 25 hips (23 patients, mean age 27 years) of which 18 with decreased (≤4°) and 7 with increased (≥28°) femoral torsion were included. All had hip arthroscopy during the same procedure in order to treat additional labrum pathologies and cam deformities. Mean follow up was 37 month (range 12–59). HHS improved from 68 to 86 ($p < 0.001$), WOMAC from 3 to 1 ($p < 0.001$), Subjective Hip Value from 52% to 72% ($p = 0.002$). Bilateral patella instability was found in one patient and considered as not related to the procedure. Femoral torsion could be normalized to a mean of 16° (±9). We detected one over- and one undercorrection. Compared to the opposite side TAGT ($p > 0.08$), patellar tilt ($p > 0.09$) and lateralization ($p > 0.26$) did not differ. No non- or delayed-union, no wound infections were encountered. One patient showed a slight in-toeing which was asymptomatic. It was not known whether this finding existed already preoperatively.
Conclusion: Subtrochanteric rotational osteotomy is in our hands a safe procedure normalizing femoral torsion resulting in subjective and clinical benefit and without having adverse effects on patella tracking.

FM131

Preoperative MRI in slipped capital femoral epiphysis: intraarticular findings, morphology and orientation of the epiphysis and chondrolabral damage

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Introduction: Slipped capital femoral epiphysis (SCFE) is a well-known pediatric condition, which is associated with development of premature osteoarthritis. Patients typically report acute or subacute onset of grown pain with, limping and frequently inability to walk. Currently the diagnostic approach mainly relies on clinical examination, biplanar radiography and increasingly MR imaging. However little is known about preoperative MR imaging findings in patients with SCFE. We aimed to characterize intraarticular findings, morphology and orientation of the epiphysis and chondrolabral damage in patients with acute and subacute SCFE undergoing surgical treatment.
Methods: After IRB approval, our surgical database was reviewed for patients with acute or subacute SCFE, which underwent preoperative MR imaging. Sixteen consecutive hips (15 patients; age 13.5 ± 1.5 years) were identified. On radial proton-density weighted images we assessed: epiphysis (callus formation, epiphyseal angle, epiphyseal tilt angle, epiphyseal extension and alpha angle), joint effusion, and chondrolabral damage.
Results: The highest epiphyseal tilt angle (2 o'clock position: –35° ± 21), epiphyseal angle (2 o'clock position: 100.5° ± 21), and alpha angle (2 o'clock position: 94° ± 22) were found in den anterosuperior region corresponding to the posteroinferior slip direction. Callus formation was in all 16 /16 hips (100%) observed in the inferior and posteroinferior quadrant. Joint effusion was observed in 13/16 (81%) of the hips. Labrum alterations were observed in all 16/16 hips (100%), and cartilage damage was observed in 12/16 (75%) both mostly localized in the anterior and anterosuperior quadrant. Time elapsed from onset of symptoms to diagnosis of SCFE was 90 days (± 70; range: 5–270).
Conclusions: Patients presenting with acute or subacute SCFE show the typical posteroinferior slip of the epiphysis, which induces joint effusion and chondrolabral damage anterosuperiorly and emphasizes the need for early surgical treatment. Callus formation was consistently observed on MRI. A large posteroinferior callus may be critical, in the development of avascular head necrosis as it possibly generate tension of the retinacular vessels during open or closed capital realignment.

FM132

MRI-based Femoral Torsion measurement is as accurate and reliable as CT-based measurement in patients with FAI

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Femoroacetabular Impingement (FAI) is a known cause for hip pain in young and active patients. Recently, abnormal femoral torsion has been described as an additional cause for FAI and is a known cause for lower extremity pathologies. CT-based measurements of femoral torsion is the current gold standard and therefore we compared MRI-based measurements with CT measurements in patients eligible for joint preserving hip surgery. We asked (1) What is the reliability in terms of mean difference and correlation between MRI and CT-based measurements of femoral torsion? (2) What is the mean difference and correlation of CT-based measurements between two readers? (3) What is the mean difference and correlation of MRI-based measurements between two readers?
Methods: A retrospective comparative radiologic study involving 21 consecutive patients (42 hips) with symptomatic FAI was performed (28 ± 10 years [17–51]). All patients underwent bilateral CT scan and bilateral MR arthrography for evaluation and diagnosis of FAI. CT scan were obtained for dynamic 3D impingement simulation. Additionally to the routine unilateral, multiplanar protocol for chondrolabral lesions, bilateral axial localizers over the distal femoral condyles and an axial TIRM sequence was acquired to measure femoral torsion. Two readers independently measured femoral torsion on both CT and MRI scans on two separate sessions according to the method described by Murphy et al in 1987. Correlation between CT and MRI was assessed using the pearson correlation coefficient because the data were normally distributed.
Results: (1) Mean difference between MRI and CT-based measurements of femoral torsion was 2.1° ± 5 (-10 – 15) for Reader 1 and 4.5° ± 4 (1-13) for Reader 2. Correlation between MRI and CT-based measurements was 0.94 ($p < 0.001$) for reader 1 and was $R = 0.91$ ($p < 0.001$) for reader 2. (2) Mean difference of CT-based measurements between two readers was 0.9° ± 4 (-9 – 7) and correlation was $R = 0.96$ ($p < 0.001$). (3) Mean difference of MRI-based measurements between two readers was 0.2° ± 5 (–13 – 7) and correlation was $R = 0.95$ ($p < 0.001$).
Conclusion: MRI-based measurement of femoral Torsion is as accurate and reliable as CT-based measurements in patients with FAI. Correlations were excellent between MRI and CT-based measurements. We changed our clinical practice and use bilateral MRI scans for preoperative measurement of femoral torsion. Thereby reducing exposition to radiation in the typically young patients

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FM133

Mean 6 year follow-up after rim trimming, labral refixation and osteoplasty for femoroacetabular impingement

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Introduction: Femoroacetabular impingement is likely to be one of the major causes of osteoarthritis. Evidence shows that surgical hip dislocation is a valid method to treat this pathology in the long term. Mid-to long term data for hip arthroscopy are however scarce. We present follow-up data of patients, who underwent rim trimming, labral refixation and osteoplasty in our institution with a mean follow-up of 6.1 years.
Methods: We retrospectively analysed data of 55 patients collected in a prospective fashion operated in 2009 and 2010. Clinical outcome was assessed by the NAHS and SF-36 scores. Rate of conversion to THR and clinical failure were evaluated. Wilcoxon test was used to assess significance.
Results: 55 patients have been followed up at a mean 73.6 (SD:11.1) months, thereof 11 with bilateral ope-rations resulting in 66 hips. 44 unilateral, 11 bilateral operations were performed on 22 women and 33 men. The mean age and BMI was 30.9 (SD: 12.4) years and 22.4 (SD: 3.3) respectively. The mean NAHS improved from a mean 66.3 (SD: 18.2) to 87.8 (SD: 14.9) ($p < 0.001$). The SF-36 physical improved from a mean 63.8 (SD: 21.9) to 84.0 (SD: 16.8) points ($p < 0.001$). Microfracture was carried out in 9 hips on the acetabular side and once on the femoral head. There were 7 patients (8 hips) with a mean age of 39.0 (SD: 8.7) years, who were considered clinical failures, scoring less than 80 points on the NAHS and 5 patients received a

THR at a mean 2.35 years postoperatively with a mean age of 47.4 years at the index operation. One hip was scored Tönnis 0, 8 hips Tönnis 1 and four hips Tönnis 2, with a median score of Tönnis 1.
Conclusion: Hip arthroscopy appears to be a reliable tool in the mid term in the management of femoroacetabu-lar impingement including rim trimming and labral refixation. However correct indication in terms of clinical and radiological signs of OA is essential.

FM134

Reproducibility of three different methods for measuring internal rotation of the hip

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Introduction: Measuring internal rotation range of motion (ROM) of the hip is one of the standard criteria of the American College of Rheumatology for the assessment of hip osteoarthritis. Limited internal rotation ROM may also suggest the presence of deformities of the femur or acetabulum in asymptomatic populations. The gold standard for measuring internal rotation ROM manually, by means of a goniometer, is however prone to measurement errors induced by uncontrolled load applied to the leg by the investigator and visual alignment of the goniometer. Thus the aim of this study was to assess the reproducibility of two different examination chairs to quantify internal rotation ROM of the hip.
Methods: Hip internal rotation ROM of thirty healthy participants (27 ± 4 yrs, 173 ± 10 cm, 68 ± 12 kg, 18 women) was assessed bilaterally by two investigators (A and B) using a) the conventional goniometer method (GON), b) a previously validated examination chair (EC1) with a constant load of 5 kg to rotate the hip and c) a newly-developed chair (EC2) with adjustable loads. Inter-observer (investigator A vs. investigator B) and intra-observer reproducibility (investigator A, one week between measurements) were measured using intra-class correlation coefficients (ICC) and repeatability coefficients using within-subject standard deviation.
Results: Average internal rotation measured by investigator A was 36 ± 10°, 43 ± 10° and 52 ± 17° while investigator B measured 31 ± 10°, 41 ± 10° and 51 ± 17° with GON, EC1 and EC2, respectively. Inter-observer ICCs of GON, EC1 and EC2 were 0.697, 0.935 and 0.995, respectively, while repeatability was 15.9°, 7.1° and 3.3°, respectively. Intra-observer ICCs were 0.926, 0.953, and 0.993 with a repeatability of 7.8°, 5.9° and 4.5° for GON, EC1 and EC2 respectively.
Conclusion: This study showed a clearly higher inter- and intra-observer agreement and lower measurement error of the EC2 when compared to the EC1 and the GON method. However, the absolute internal rotation obtained with EC2 cannot be compared to the other methods as mean angles and inter-subject variability are higher. This means that the EC2 may not be well suited for the assessment of standard criteria of osteoarthritis (which are based on values of the GON method), but may be an excellent method to quantify changes in hip internal rotation between observers and over time. This may particularly be useful for the early detection of deformities of the hip, such as femoroacetabular impingement.

POSTERS

P1

What is the best glenoid configuration in reverse shoulder arthroplasty?

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Purpose: The impacts of glenoid offset and the combination between glenoid and humeral design after reverse shoulder arthroplasty (RSA) have not been well-studied, particularly with regard to flexion/extension and to internal/external rotation which have been demonstrated to be the cause for scapular notching. The purpose of this study was to analyze the effect of different glenoid designs, and then of combination of glenoid and humeral designs on arm position and range of motion (ROM) following RSA.
Methods: Using a three-dimensional computer model of RSA, a short curved onlay stem with a 145° inclination was combined to five different glenoid design varying by glenoid sphere diameter and glenoid sphere center of rotation location. Glenoid offset, acromiohumeral distance (AHD), ROM and muscle length were evaluated for each configuration.
Results: Altering glenoid design led to a nearly 6 mm change in glenoid offset and 3 mm in the AHD. There was a 7° improvement in abduction and flexion between the different glenoid design. Only 2 of them, the 36 mm centered and the Bio-RSA, did not reach native adduction. In extension and external rotation arm at side, the eccentric 36 mm sphere was the best configuration. The 42 mm sphere present a limited external rotation at 90° of abduction. When combining glenoid and humeral design, a threshold of 1.8 on the Humeral Offset/AHD discriminated between configuration with external rotation limitation or deficit.
Conclusions: With varying glenoid prostheses, dramatic change could be observed on extension, external rotation arm at side and external rotation at 90° of abduction. Taking particular attention to a low placement of the glenoid implant, which could be increase by using eccentric sphere, is important as this directly improvement ROM.

P2

What is the best surgical knot for high-strength suture material? A biomechanical study

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Background: Almost every surgery requires the use of surgical knots. Double-stranded looped configuration may be advantageous due to fewer free suture ends and machanical properties. The objective was to compare novel looped to conventional knot configurations.
Methods: In an in vitro biomechanical study, 12 different knots were repeatedly (five times each) tested with a distraction material testing machine with a constant displacement speed (0.2 millimeters/second [mm/s]). The knots were the conventional half hitch, square knot with secured ends, eight-sling-eight with secured ends, Nicky's knot, Nice knot, racking hitch, cow hitch (Larks head), clove hitch, altered (arthroscopic version) cow hitch with four knots, altered clove hitch with four knots, altered cow hitch with five knots, altered clove hitch with five knots. Afterward, the cow hitch, its arthroscopic version, and conventional half hitches were investigated on bovine tendon. Braided polyblend non-bioresorbable suture material was used. Knot security (stiffness) at assumed clinical failure (≥3 mm displacement) was the primary outcome. Size and loop security (maximal tension) was the secondary outcome. A power analysis was done based on pre-test results. Oneway ANOVA and post hoc tests with Bonferroni correction was used to compare groups. Statistical significance was assumed for p-values <0.05.
Results: Compared to one and a half- and single-stranded knots, double-stranded looped knots were up to three times stronger. The stiffest knot was the cow hitch (mean 184.7 [95% confidence interval 172.0–197.4] Newton [N]/ mm) ($p < 0.001$), tailed by the Nice knot (168.6 [154.0–183.2] N/mm). Coventional half hitches were less stiff (65.4 [52.9–77.9] N/mm). These findings remained in tendons (81.8 [77.1–86.4] and 40.4 [32.0–48.8] N/mm, $p < 0.001$). Half hitches (9.5 mm^3) were larger than cow hitches (7.6 mm^3) and Nice knots (6.1 mm^3). Cow hitches had higher loop security than half hitches (157.6 [119.6–195.6] N and 85.0 [56.9–113.2] N, $p < 0.001$).
Conclusions: Double double-stranded surgical knots with a loop on one side are mechanically stiffer (stronger), smaller, and keep applied tension better than conventional knots. The cow hitch and Nice knot seem to be the knots with the best performance, while being simple to tie.
[Note: This abstract has also been submitted to the 18th EFORT Congress 2017, Vienna, Austria.]

P3

Comparative analysis of Friedman's and the vault measurement methods for glenoid version according to CT scan slice height and angulation

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Introduction: Most glenoid version measurement methods have been validated on 3D-corrected axial CT slices at the mid-glenoid. This is not necessarily applicable for reverse arthroplasty where the baseplate is usually aligned with the lower-glenoid, and no study has yet analysed variation of the vault according to slice height and angulation. The aim of this study was to analyse variation of glenoid vault compared to Friedman's angle according to different CT scan slice height and angulation.
Methods: 60 consecutive right shoulder CT scans were retrieved from a hospital imaging database and were reconstructed in the plane of the scapula. 7 axial slices of different height (mid-, lower-, upper-glenoid), and coronal angulation (–20 to +20°) were then selected, and measures were carried out by 3 observers. Intra- and inter-observer reliability was checked with Bland-Altman.
Results: Mid-glenoid mean version was –7.9° (±5,0, range –9.2 to –6.6) and -2.0° (±4.7, range –3.2 to –0.8) according to the vault and Friedman's angle, respectively. For both methods, decreasing slice height or angulation didn't affect version. The vault was however significantly more anteverted when increasing slice height (+12.1°, range 10.5 to 13.6, p <0.001), or angulation (+10.3°, range 8.98 to 11.7, p <0.001). Both intra- and inter-observer reliability were higher using Friedman's angle (P <0.008).
Conclusion: Version at the mid- and lower- glenoid are similar using either method. However, version relative to the vault shows less reliability and more variability to slice height or angulation. Yet, as it significantly differs from Friedman's angle, it should still be used in situations where maximum bone purchase is sought with glenoid implants. For any other situation, Friedman's method remains recommended.

P4

Patient-specific guides to help position augmented glenoid components for biconcave glenoids in total shoulder arthroplasty

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Introduction: Preoperative planning softwares and patient-specific guides have become available to help improve the positioning of the glenoid component in anatomical total shoulder arthroplasty (aTSA). In addition, for biconcave glenoids with a substantial wear, augmented glenoid implants are proposed to better adapt to the remaining glenoid cavity. The objective of this study was to compare the glenoid implant position and humeral head subluxation between preoperative planning software and postoperative CT.
Methods:A total of 7 patients (4 women) with a mean age of 68 years (50–78) were prospectively included in this study. All patients underwent aTSA with an augmented glenoid implant (PerForm+, Tornier) to compensate for substantial biconcave wear. Blueprint software was used for preoperative planning. The keeled glenoid implants were positioned using patient-specific guides. Patients underwent standardized preoperative and postoperative shoulder CT scans. Reduced-dose postoperative CTs were performed using iterative reconstructions and dual-energy CT with a metal artifact reduction algorithm. Preoperative and postoperative CTs were registered with Amira software, using six bony landmarks. The two metallic cylinders within the implant were segmented on the postoperative CT, and the implant computer-aided design file was registered to these cylinders. The registrations were assessed visually with Amira. Postoperative implant position and orientation was measured using the same preoperative coordinate system used by planning software. Preoperative and postoperative subluxation was measured in 3D as the ratio of the humeral head offset from the scapular axis and humeral head radius.
Results: The difference between planned preoperative and measured postoperative version (inclination respectively) of the glenoid component was 0.9° ± 6.1° (3.0° ± 3.9° respectively). Humeral head subluxation was reduced from 54% ± 7% to 26% ± 12%), and remain postero-superior.
Conclusion: This initial study shows that the planned positioning of the augmented glenoid implant was obtained, within the error of the measurement method. Although the measurement error was actually not calculated, we estimate that it could be 5°. We conclude that augmented glenoid implants positioned with preoperative software and patient-specific guides can efficiently correct the worn glenoid cavity and reduce the humeral head static subluxation.

P5

Shoulder arthroplasty complications: definition of a core event set by Delphi consensus process

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Introduction: Valid reporting of the occurrence of shoulder arthroplasty (SA) complications requires standardization. We aim to define a consensus core set of negative events (CES) of SA.
Materials and Methods: We initiated a Delphi consensus process with on-line surveys. An international panel of 185 experienced shoulder surgeons was nominated through professional Societies. Based on a systematic review and a recently developed CES in arthroscopic rotator cuff repair, an initial survey was implemented with two parts: one concerning imaging parameters for SA monitoring and the other covering intra- and postoperative adverse events. Open questions captured the experts' opinion. For closed questions about event groups, definitions, specifications and timing of occurrence, consensus was reached with two-third agreement.
Results: Eighty-nine surgeons (48%) responded. Consensus was reached to further consider and define 8 radiological parameters (radiolucency, loosening, implant migration, signs of instability, bone resorption, stress shielding, scapular notching and implant wear). Consensus with 91–93% agreement was reached for a core list of local events including 3 intra-operative event groups (device, osteochondral, soft tissue) and 8 post-operative event groups (device, osteochondral, pain, surgical site infection, peripheral neurological, vascular, superficial soft tissue, deep soft tissue), along with definitions and specifications. Suggestions for modifications were made. The timing for monitoring postoperative events remained uncertain.
Discussion/Conclusion: A structured core set of local radiological parameters and adverse events of SA is being developed by international consensus. Further Delphi surveys and meetings are required to reach a final agreement as a major step towards the standardization of SA complications.

P6

PARP-1 inhibition improves healing in a rat model of acute rotator cuff repair

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Introduction: Repair of rotator cuff tears (RCT) have a high retear rate due to the formation of mechanical inferior scar tissue during the healing period and so far there is no way to improve it therapeutically. We hypothesized that PARP-1 inhibition improves biomechanical and histological properties of the repair in a rat model of acute rotator cuff repair.
Methods: 24 Sprague Dawley rats were randomly allocated into an Inhibitor and Control group (n = 12 each). In all rats the tendon of the supraspinatus muscle was sharply detached from its insertion at the humeral head and immediately repaired with a single transosseous suture. Starting one day prior to surgery the rats of the Inhibitor group received 12.5 mg/kg/d Veliparib in their drinking water (ABT-888, APExBio, TX, USA), which continued during the recovery period. The water uptake was monitored to assure accurate uptake of the inhibitor. The animals were sacrificed 8 weeks after surgery and analyzed utilizing macroscopic, biomechanical and histological methods.
Results: Macroscopically the SSP muscles of the Inhibitor group had a significantly higher cross sectional area at their midsubstance (p = 0.034). In total the Inhibitor group had a significantly better histological grading of the longitudinal joint sections than the Control group (p = 0.022) with less scar tissue formation and a tendency to better formation of the neo-entheses, less vascularity of the tendon and better tendon organization. Muscle fiber diameter in the quadrant with high mechanical demand was significantly higher in the Inhibitor group (p = 0.0004). During biomechanical testing most of the

specimens in the Inhibitor group failed in the tendon midsubstance (n = 4/6), whereas most of the Controls failed at the entheses (n = 4/6). The differences in yield load, stiffness, energy absorbed to failure and ultimate load did not reach statistical significance.
Conclusion: Inhibition of PARP-1 activity leads to a better histological healing of the RCT repair, which leads to failure at the tendon midsection during biomechanical testing; in addition, it leads to both higher histological muscle fiber cross-section and higher macroscopical muscle diameter. Although biomechanical properties were not significantly different between the groups due to being underpowered, the PARP-1 inhibitor group showed a general trend of improvement. Taken together we conclude that PARP-1 inhibition is beneficial for the healing after acute rotator cuff repair.

P7

Inter- and intra-observer variability of glenoid track measurements

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Background: Recently a method of assessing combined glenoid and humeral bone loss in traumatic shoulder instability with an associated treatment protocol was published (Di Giacomo et al). The aim of this study was to investigate its reliability and reproducibility.
Methods: 71 patients with unilateral antero-inferior shoulder instability underwent CT scans, from which 3D images were derived. En-face views of both glenoid fossae, along with 3 views of the humeral head were provided to 4 assessors to determine inter-observer reliability. From these measurements the shoulder was assigned a treatment classification. Two ob-servers repeated their assessments a month later to determine intra-observer reliability. For each measurement, the mean Co-efficient of Variability (CoV) was calculated.
Results: Assessment of glenoid bone loss showed good inter-observer (4 observers agreeing in 90.1% of cases) and also a good intra-observer agreement (94% and 96%). There was a poor level of inter-observer reliability regarding On- or Off-track classification (72%). Intra-observer reliability for this measurement was less variable (90% and 80%). There was a poor level of agreement between observers (65%) regarding treatment classi-fication. The CoV for the Hill-Sachs lesion measured 19.2%, indicating a high level of variability for this measurement, compared with <4% for all other measures.
Conclusion: Linear bone loss on the glenoid can be measured reliably and reproducibly, however eva-luation of Hill-Sachs lesions demonstrates a high level of variability, and poor inter-observer reliability.

P8

Are pendular shoulder exercises worthwhile?

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Introduction: Codman's pendular exercises have been widely used for decades with the intention of passively mobilizing the glenohumeral (GH) joint while not compromising recently injured or repaired tissues. However, no studies have yet shown that they actually result in true GH movement. The aim of this study was thus to quantify GH motion during pendular exercises with the hypothesis was that they involved little if any true GH motion.
Methods: 10 healthy volunteers were involved in this study. Shoulder kinematics were analyzed based on a validated biomechanical model coupling patient-specific imaging and motion capture, during which participants were instructed to perform medio-lateral, antero-posterior and circular pendular exercises. GH range of motion (ROM), scapulothoracic (ST) ROM, thoracohumeral (TH) ROM and overall exercise amplitude were calculated for each sequence. Linear regression analyses were carried out to determine any association between different components of shoulder motion.
Results: Mean overall exercise amplitudes were 36.48° ± 9.74° (range, 25.38 to 56.39°) for medio-lateral exercises, 38.3 ± 14.97° (range, 20.68 to 64.99°) for antero-posterior exercises, and 21.44° ± 7.72° (range, 14.01 to 35.49°) for circular exercises. Mean GH and ST involvement remained minimal, ranging from 4.88 to 10.77°, and 1.4° to 4.19°, respectively. There was no significant correlation between overall exercise amplitudes and GH ($R = 0.38$, $p = 0.01$) or ST amplitudes (adjusted $R2 = 0.3$, $p = 0.006$).
Conclusion: This study demonstrates that Codman pendular exercises depend mainly on truncal movement, and produce very little movement of the GH and ST joints. The use of these exercises for passive shoulder rehabilitation is thus questionable.

P9

Outcome of revision rotator cuff repair

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Introduction: Structurally failed rotator cuff repair is not necessarily associated with a poor clinical outcome, but sometimes may require further surgical treatment. Often, revision rotator cuff repair is performed, with however very little data available in the literature to help in the decision making process. The goal of the here presented work was to analyze our results in this set of patients.
Methods: Isolated revision rotator cuff repair was performed at our institution from Jan 2008 to Dec 2012 in 51 subjects (mean 53 years), of these, 31 were available for clinical and radiological (ultrasound) follow up (mean 32 months), including Constant score (CS), subjective shoulder value (SSV), and pain (VAS).
Results: Of the 31 patients, there were 9 recurrent failures, including 7 supraspinatus, 4 subscapularis and 1 infraspinatus repairs, and in 7 patients a trauma was recorded. In the intact versus failed shoulders, the age adjusted constant score improved from 55 to 76 points and 55 to 65 points respectively, global flexion from 131° to 147° and 122° to 130° respectively, SSV from 48 to 69 points and 40 to 46 points, respectively, VAS from 5.2 to 2.2 and 5.9 to 4.8 points, respectively. Force improved from 2.1 to 3.7kg and 2.0 to 2.6 kg. For the intact versus failed cuffs, for the pre- versus postoperative fatty infiltrations (if available) were SSP: 1.8 to 1.4 and 2.3 to 3.8, ISP: 2.0 to 1.5 and 1.8 to 2.3. SSC: 1.3. to 1.0 (failed n.a.).
Conclusion: Revision rotator repair has the potential to improve patient satisfaction from SSV 48 to 69 points, with objective improvements in function and pain. However, if the revision fails, the results appear far inferior to a failure in a primary repair (SSV 40 to 46 points), particularly regarding pain, with almost no improvement there. This represents the largest study analyzing the outcome of revision cuff repair with a relatively low recurrence rate compared to previous reports. If conditions are favorable, mostly represented by good muscle quality, revision rotator cuff repair may be a useful treatment option with a final outcome not necessarily far inferior to primary repair.

P10

Brain does not heal after shoulder stabilization

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Shoulder apprehension is more complex than a pure mechanical problem of the shoulder, creating a scar at the brain level that prevents the performance of specific movements. Surgery corrects for shoulder instability at the physical level, but a re-dislocation within the first year is rather common. Predicting which patient will be likely to have re-dislocation is therefore crucial. We hypothesized that the assessment of neural activity at baseline and follow-up is the key factor to predict the post-operatory outcome. 13 patients with shoulder apprehension (30.03 ± 7.64 years) underwent clinical and fMRI examination before and one year after surgery for shoulder dislocation contrasting apprehension cue videos and control videos. Data analyses included task-related general linear model (GLM) and correlations imaging results with clinical scores. Clinical examination showed decreased pain and increased shoulder functions for post-op vs. pre-op. Coherently, GLM results show decreased activation of the left pre-motor cortex for post-surgery vs. pre-surgery. Decreased orbito-frontal activity predicts good recovery of shoulder function measured by STT. Our findings demonstrate that beside physical changes, changes at the brain level also occur one year after surgery. In particular, decreased activity in pre-motor and orbito-frontal cortex is key factor for a successful post-operatory outcome.

P11

Computer-assisted corrective osteotomies of midshaft clavicle malunions – a novel contact-optimized lengthening stepped osteotomy

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Introduction: The incidence of clavicle malunions, after conservative and operative treatment of clavicle fractures, was assumed in the past to be low. Recent studies revealed that symptomatic malunions occur in 9% of non-operatively treated patients with a displaced midshaft clavicle fracture The surgical treatment of malunions after midshaft clavicle fractures is associated with a number of potential complications and the surgical procedure is challenging. However, with appropriate and meticulous preoperative surgical planning, the surgical correction yields satisfactory results. The purpose of this study was to provide a guideline and detailed overview for the computer-assisted planning and three-dimensional (3D) correction of malunions of the clavicle.
Methods: 3D bone surface models of the pathological and contralateral side were created based on CT data. The computer-assisted assessment of the deformity, the preoperative plan, and the design of patient-specific guides enabling compression plating were described.
Results: We demonstrate the benefit and versatility of computer-assisted planning for corrective osteotomies of malunions of the midshaft clavicle. In combination with patient-specific guides and compression plating technique, the correction can be performed in a more standardized fashion. We describe the determination of the contact-optimized osteotomy plane. An osteotomy along this plane facilitates the correction and enlarges the contact between the fragments at once. We further developed a novel technique of a stepped osteotomy that is based on the calculation of the contact-optimized osteotomy plane. The stepped osteotomy enables to restore the length without the need of structural bone graft. The application of the stepped osteotomy is presented for malunions of the clavicle with shortening and excessive callus formation.
Conclusion: 3D preoperative planning and patient-specific guides for corrective osteotomies of the clavicle may help to reduce the number of potential complications and yield results that are more predictable.

P12

The accuracy of arthroscopic fluid pump systems in shoulder surgery. A comparison of five different pump systems and settings

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Introduction: Potential fluid management complications, including extraarticular fluid extravasation, can arise during shoulder arthroscopy. This risk relates directly to fluid pressure and operative time. The pressure ranges recommended by different arthroscopic pump manufacturers vary widely, creating confusion over this important safety issue. The purpose of this study was to compare the pressure measurement accuracy of three common arthroscopic fluid pump systems in five different settings.
Methods: Patients (n = 25) undergoing shoulder arthroscopy were randomly selected for this study. Based on where the patient was having surgery, one of three arthroscopic fluid pump systems in our hospitals (Conmed 24K, Stryker Crossflow, Arthrex Dual Wave) was present in the operating theatre. The Stryker pump was tested in bothe its available modes: standard and dynamic. The Conmed pump was tested with and without the TIPS (extra tubing detecting intra-articular pressure). Each pump at each setting (30–90 mm Hg in 10 mm Hg increments) was tested on 5 different patients. The set pump pressure was documented and the equivalent intra-articular fluid pressure was measured at the beginning of the surgery using an intra-articular spinal needle connected to the anaesthetic machine via an artery line.
Results: The mean intra-articular pressure was not different to the set pressure for Conmed 24K with TIPS (0.98 ± 0.02 fold) and Stryker Crossflow in standard mode (0.98 ± 0.02), however it was significantly higher than the set pressure for Conmed 24K without TIPS (1.30 ± 0.13 fold), Stryker Crossflow in dynamic mode (1.82 ± 0.08) and Arthex Dual Wave (2.19 ± 0.06; all P <0.001). The mean differences between the displayed pump pressure and measured intra-articular pressure in mmHg were as follows: Conmed 24K with (2.9 ± 2.6) or without (29 ± 16) TIPS, Stryker Crossflow in dynamic (80 ± 19) or standard (7.7 ± 2.6) mode and Arthex Continuous Wave III (76 ± 25).
Conclusion: Actual intra-articular pressure can be more than double the set pressure on some arthroscopic pumps. Measuring intra-articular pressure can aid in adjusting the set pressure. To achieve a 'true' pressure of 60 mm Hg, we suggest setting the Arthrex pump to 25–30 mm Hg, the Stryker pump to 55–60 in standard mode and the Conmed pump to 55–60 if using the TIPS. This could minimize the risk of fluid extravasation into the soft tissues and any further related complications.

P13

ORIF of scapular spine fractures after reverse total shoulder arthroplasty with a double plating technique

Dr. Felix Toft, Dr. Tomas Drobny

Background: Scapular spine fractures after reverse total shoulder arthroplasty (RTSA) are a severe complication, compromising patient satisfaction and shoulder function, sometimes even leading to instability of the shoulder prosthesis with resulting joint dislocation. Conservative management has been the dominant treatment choice in the past. The purpose of this study was to describe our experiences with surgical management of these fractures in 5 Patients, including surgical approach, implant choice for internal fixation and rationale behind fixation method, and to present the early clinical outcome.
Methods: From September 2015 on, patients with above mentioned fractures were informed about conservative as well as surgical treatment options and the inherent risks and chances of either choice. Patients were only treated with ORIF after elaborate informing about the pros and cons of ORIF and our previous unsatisfactory experiences with this complication under conservative management, and patients consent (informed consent). All 5 patients agreed to undergo surgery.
Results: All patients were female with a mean age of 76 years (range 73–81, ±3.3 years). Four of the five (80%) treated patients had osteoporosis confirmed by DEXA, the fifth had Vit. D substituion due to a suspected osteopenia/-porosis. Four out of five (80%) patients had a diagnosed depression with antidepressive medication. Mean time from RTSA surgery to fracture occurance was 60 months (range 4–113, ±45.2 months). Mean time from fracture occurance to surgical treatment was 17.2 weeks (range 1–52, ±21.2 weeks). A bicortical iliac crest bone graft with additional cancellous bone grafting was used in 2 patients (nonunions), cancellous bone grafting alone in further 2 patients (delayed unions) and 1 patient was treated with ORIF alone (acute fracture). All surgically treated scapular spine fractures healed (100%). Two patients had one complication (iatrogenic pneumothorax, screw loosening) with only the pneumothorax requiring further treatment (chest tube insertion). Patient satisfaction and shoulder function increased, pain levels decreased (Constant/ASES/quickDASH) at 12 months post surgery compared to preoperative values.
Conclusions: ORIF for scapular spine fractures after RTSA with the surgical technique presented seems to achieve reproducible good results with bony union and improved outcome scores despite osteopenic/-orotic bone quality.

P14

Unexpected shocking bleeding in a case of humeral head fracture – dislocation

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Lesions of the axillary artery in case of blunt trauma are rare. They are generally associated with a mechanism of hyper-abduction of the arm. The goal of the abstract is to present a peculiar case with review of the literature. A 50-years-old woman, known for previous use of recreational drugs and paranoid schizophrenia, comes to the Emergency Department after a ground-level fall with blunt right shoulder trauma. The physical examination of the right shoulder showed soft tissue swelling and tenderness. The skin was pink and warm. Radial and ulnar pulses were palpable. Capillary refilling time <2 s. No neurological deficit was present. Radiographs showed anterior dislocation and a three part humeral fracture requiring open reduction and osteosynthesis. Through a delto-pectoral approach, an attempt of reduction of the humeral dislocated head was performed. Suddenly, an expected massive shocking bleeding occurred from the axillar region. The bleeding was stopped temporarily by compression until the vascular surgeon revised the area finding aa pre-existing laceration of about 4–5 cm of the axillary artery. Osteotomy of the coracoid process gave more access for the thrombectomy and a

reversed greater saphenous vein interposition graft from distal subclavian to proximal axillary artery were performed. Fracture is reduced and fixed with a Philos plate, coracoid process is fixed with a cannulated screw. Interestingly, the few cases described in literature generally showed preoperatively signs of vascular impairment, mainly pulselessness, paleness, pain and paraesthesia. Therefore, the main message of this case report is that, with a fracture-dislocation of the proximal humerus, although no anamnestic, clinical or imaging sign indicated any vascular impairment, we should always be ready for such complications and if they occur, a vascular surgeon is needed.

P15

Static inferior shoulder subluxation: a case series

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Introduction: Instability of the shoulder is a condition well accessible to both conservative and surgical treatment options. Operatively, arthroscopic soft-tissue procedures as well as open bone block procedures are routinely employed, depending on the underlying pathomorphology. However, these methods are insufficient for certain types of instabilities, one of them being static inferior instability. We report on a series of 4 cases.
Materials and Methods: Four patients aged 20 to 37 are currently treated for static inferior shoulder subluxation. Clinical and imaging work-ups (radiographs, MR- and/or CT-arthrographies), including neurological/neurophysiological exams, have been performed repeatedly. All have already undergone several surgeries. To address dysfunction of the superior glenohumeral and coracohumeral ligaments as well as capsular laxity, tightening of the rotator interval and inferior capsular shift were performed. As all measures failed, outside opinions were sought. A survey including a presentation of patient histories/findings was emailed to a group of experts in shoulder surgery. Respondents were asked to select 1 out of 7 treatment options (no surgery, arthroscopy, (revision) bone block, reversed total shoulder arthroplasty, glenohumeral joint fusion, other) and to elaborate on the topic. 43 responses were gathered and analyzed. Our patients are scheduled for follow-up visits (orthopaedic, neurologic, radiographic; Constant Score) shortly.
Results: Neurological dysfunction (axillary/suprascapular) could be ruled out in all patients. Their conditions appear to be caused functionally and/or mechanically. One patient with additional advanced osteoarthritis will be recommended glenohumeral joint fusion (survey vote: 51.2%). In the other 3 cases, the majority of survey respondents opted for a conservative treatment agenda, specifically, specialized physical therapy for improvement of delta muscle function, complemented by pain management (survey votes: 30.2, 40.5, and 53.7%). However, some operative solutions, such as open capsular shift, were also proposed more frequently and will be considered.
Conclusion: Static inferior shoulder subluxation is a rare variant of shoulder instability. Patients suffer of pain, dysfunction, and hence, psychological strain. No reliable treatment method is known. In the scope of this study 4 such cases were presented to an expert panel via online survey. Yet, no consensus regarding treatment could be reached.

P16

Arthroscopy guided corrective osteotomy for intra-articular distal radius malunion. A case report

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Introduction: Malunion is the most common complication of distal radius fracture (Prommersberger et al. 2006). A malunion with a step-off of 1 mm or more after an intra-articular distal radius fracture may cause pain and arthritic changes at midterm follow-up (del Piñal et al. 2008).
Methods: A 28-years-old man was involved in a bicycle accident against a car (30 km/h), with reception on his right wrist. Plain radiographs did not show any fracture. Two months later, the patient was still suffering of pain by flexion-extension of the wrist. CT-scan and MRI showed an intra-articular partially healed fracture of the palmar lip of the intermediary column of the radius, with a step off of 1 mm in the fossa lunata. Wrist arthroscopy allowed identifying the step-off of the fossa lunata easily. Osteotomy at the appropriate location and later reduction were performed through a modified Henry approach under arthroscopic control to achieve perfect congruity of the articular surface. The fragment was stabilized with 1.5 mm LCP plate (Aptus Hand System).
Results: The JAMAR gripping force at 6 weeks postoperative was at 32 kg (64% of contra lateral side) respectively 44 kg (90% of contra lateral side) at 3 months postoperatively. Range of motion at 3 months postoperative was: flexion-extension 90-0-75° and pro-supination 80-0-90°. The preoperative Patient-Rated Wrist Evaluation (PRWE) score was 40/160 and 3 months postoperative was 13/160.
Conclusion: A 1 mm step-off in intra-articular malunion of the distal radius may be symptomatic and should be corrected. Therefore arthroscopically assisted correction is a valuable technique to control the exact site of the articular osteotomy as well as the reduction of the articular surface in such cases.

P17

Collateral ligament reconstruction of the proximal interphalangeal joint in chronic instability. Case report and description of technique

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Introduction: Chronic instability of the proximal interphalangeal joint (PIPJ) of the finger is a rare condition. Surgical treatment is necessary only in cases of failed conservative treatment or symptomatic instability. Several operative techniques have been described. Chronic lesions leading to PIPJ instability can be treated by ligament reconstruction, tenodesis or joint fusion. We introduce a new surgical method using a tendon autograft to reconstruct the collateral ligament of the PIPJ.
Case Report and Surgical Technique: A 17 years old female patient presented with symptomatic posttraumatic chronic radial PIPJ instability of the index finger. Radiographs under lateral stress demonstrated a radial instability of more than 20°. Initial treatment included hand therapy and buddy taping to the adjacent finger, but conservative management failed and surgery was planned to reconstruct the ligament and to regain joint stability. Our simple method positions the tendon autograft anatomically, corresponding the original course of the lateral collateral ligament and potentially also the accessory collateral ligament. Fixation of the graft is secured by a wire loop whilst Tendon-to-Bone healing is sought. With our method impairment of other dynamic stabilizers of the PIPJ is avoided and no wide drill holes are needed. Postoperative care consists of immobilization for a few days and then buddy taping for 6 weeks.
Results: At 6 month postoperative the patient presented a stable PIPJ with full range of motion and reported no complaints of pain or instability. She resumed full daily activity.
Conclusion: We introduce a new surgical method using a tendon autograft to reconstruct the collateral ligament of the PIPJ in chronic instability. Our method avoids potential drawbacks of the previously reported techniques like disruption of the other dynamic stabilizers. Our method can be used not only to reconstruct the lateral collateral ligament but also the accessory collateral ligament and is suitable for revision surgery as well.

P18

CT-based evaluation of bone density in fragility fractures of the sacrum – a matched case-control-analysis

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Introduction: The gold standard for measuring the bone mineral density is dual energy x-ray absorptiometry (DEXA), which is, however, not always readily available. Computed tomography (CT), on the other hand, is a standard diagnostic procedure in patients with fragility fractures of the pelvis. CT can allow for an evaluation of the bone mineral density using the absolute density values (Hounsfield Units; HU). The aim of this study was to compare the CT-based bone density measured by HU in patients with and without fragility fractures of the sacrum.
Methods: Consecutive patients aged >50 years who sustained as fragility fracture of the sacrum between 01/2006 and 10/2016 and had an in-house DEXA of the lumbar spine were compared to patients of same age and gender who had a fall from standing height without fracture (matched case-control-analysis; n = 30) and a retrospective chart review was performed. In CT scans, bone density was measured by HU in the Corpus and Alae of S1.
Results: Patients with a sacral fracture showed a significantly lower average bone density in the Corpus of S1 (HU 88 ± 22) when compared to the matched control group without fracture (HU 119 ± 46; Paired Samples T test, p = 0.039). The CT-based bone density did not

correlate with the DEXA values of the lumbar spine (R = 0.195, p = 0.302). In the regional analysis, especially the Alae of the fracture group had a lower bone density when compared to the control (HU –27 ± 29 vs. 11 ± 30, Paired Samples T test, p = 0.001).
Conclusions: Patients with fragility fractures of the sacrum showed a lower general and regional bone density of the sacrum when compared to a control group matched for age, gender and trauma. This difference was especially seen when comparing the Alae of S1, those being the possible Achilles' tendon of the sacrum.

P19

Surgical decompression for foraminal and extraforaminal lumbar disc herniation using the far-lateral approach: patient-rated outcome depends on the involved segment

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Introduction: Decompression for lumbar foraminal to extraforaminal nerve compression is commonly performed using a far-lateral transmuscular approach (FLA), and is typically associated with good patient outcomes. Results are usually reported as the average for all lumbar levels; however, clinical results may be less predictable for surgery at the lumbosacral level, due to its unique anatomic features. This study compared patient-rated outcomes after far-lateral decompression at L5/S1 compared with higher lumbar levels.
Methods: This was a retrospective study of prospectively collected data from 115 consecutive patients (73 m, 42 f; mean age 62 ± 11 yrs) who had undergone surgery at a single level (N = 89 at L1 to L5, and N = 26 at L5/S1) from 1.1.2005–1.6.2014. 1482 patients from the Spine Tango database, who had undergone removal of disc herniation (non-FLA approach) served as controls. The multidimensional Core Outcome Measures Index (COMI), including scales for leg pain (LP) and back pain (LBP), was completed before surgery, and up to 2 years after surgery.
Results: 94% of the patients had completed a baseline COMI, 88% a 2-year; 83% had completed both timepoints. In the FLA group, at the 2-year follow-up, the reduction in LP was significantly (p = 0.03) less for those operated at L5/S1 (2.6 ± 2.9 points) than for those operated at L1/2 to L4/5 (4.2 ± 3.4 points) unlike in the control group (4.5 ± 3.2 points for L5/S1 and 4.2 ± 3.3 points for L1/2 to L4/5). A 2-point MCIC score for LP was achieved by 77% patients in the control group, both for those operated at L5/S1 and those operated at higher lumbar levels alike. In the FLA group, the corresponding figures were 63% (L5/S1) and 81% (higher lumbar levels) (p = 0.11). The reduction in COMI score showed a similar pattern to that for LP, but without statistical significance: at L5/S1, FLA 3.5 ± 2.4 points vs control 4.6 ± 3.0 points reduction; at higher lumbar levels, FLA 4.8 ± 3.0 vs control 4.8 ± 2.9 points). There were no significant differences (p >0.05) dependent on group or lumbar level for the improvement in LBP.
Conclusion: Decompression of extra- and intraforaminal nerve root compression using FLA results in good patient-rated outcome at 2 years. However, the improvement in LP was inferior for the L5/S1 level compared with the other levels. This may be due to its unique anatomy. These results are important in decision-making for appropriate surgical treatment and in the management of expectations during the consent process.

P20

Preliminary clinical and radiological results of an expandable PEEK-cage as anterior vertebral body replacement

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Introduction: Recently cages fully made from PEEK or carbon became popular especially in tumor surgery. They are mostly crafted as monobody cages without expandable options. This study was set up to evaluate the applicability, efficacy and safety of a new expandable PEEK cage as vertebral body replacement.
Methods: Consecutively implanted PEEK-XRL-Cages® (Depuy/Synthes) for anterior column reconstruction in thoracolumbar trauma and tumor cases were retrospectively analyzed. The modular implant consists of a central body which can be filled with bone graft on which two endplates are attached. All parts can be customized to the individual intraoperative situation. Clinical and radiological follow up were performed 2, 6 and 12 months post operatively. After 12 months a CT scan was performed in most cases to evaluate osseous consolidation. Standing-x-rays were performed at every follow-up. Bi-segmental kyphosis angle and cage height were measured. Descriptive analyses have been executed.
Results: 52 cages have been implanted since 2013 (31 male, mean age 45.9 y); 42 in trauma (15 paraplegic), 10 in spinal metastatic diseases; 1 mono-segmental, 38 bi-segmental and 3 three-segmental ventral fusions were performed. There were no intraoperative and 4 perioperative complications: two hematomas and one wound breakdown. One patient died ten days post-operatively due to his underlying tumor disease. 39 patients could be followed up for a mean of 0.7 (0.1–2.5) years. The radiologic analysis showed 2 cases of implant malpositioning and 4 cases of early subsidence which were all secondary stable. No revision surgery was required in all cases. No collapse or malfunction of the modular expansion system was documented. A mean loss of two degrees bi-segmental lordotic correction angle was documented in the last follow up (mean 0.7 years). 23 patients received a CT-scan at mean 0.9 years post-operatively. 18 showed continuous, 5 showed incomplete osseous consolidation with stable implants.
Conclusion: The modular, expandable XRL-PEEK-Cage showed promising preliminary clinical and radiological results in 39 cases with a mean follow up of 0.7 years. No implant related complication or collapse of the cage itself could be seen. Therefore, the implant seems to be save for anterior vertebral body reconstruction in trauma and tumor patients. Further extensive long term data need to be evaluated.

P21

Clinical improvement after decompression surgery reflects improved gait symmetry during a six minute walking test in patients with symptomatic lumbar spinal stenosis

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Introduction: Symptomatic lumbar spinal stenosis (sLSS) is the most common reason for spinal surgery in patients older than 65 years and leads to functional limitations such as reduced walking and standing ability. However, objective measurements of gait and gait asymmetry during prolonged walking are limited. The objective of this study was whether expected postoperative improvements in clinical scores are related to improvements in gait symmetry during a 6-min walk test (6MWT).
Methods: Twenty patients with sLSS (9 female; age, 72.0 ± 6.4 years; body mass index, 28.5 ± 5.2 kg/m^2) scheduled for decompression and, if required, fusion surgery of the symptomatic level were included after providing informed consent. Patients completed the Oswestry Low Back Pain Disability Index 2.1 (ODI) on the day prior to surgery and 10 ± 3 weeks postoperatively and performed a 6MWT. Gait patterns and asymmetry were recorded with inertial sensors (RehaGait, Hasomed GmbH, Magdeburg, Germany) during the first and last minute. Spatiotemporal parameters (e.g. stride length, stance phase) and sagittal ankle, knee and hip kinematics were calculated by the RehaGait. Gait asymmetry was defined as 100*|right-left|/(0.5*(|right+left|)) for spatiotemporal parameters and as |right-left| for maximum joint angles. Differences between pre- and postoperative data were detected using paired t-tests (α <.05). Relationships between changes in ODI and gait asymmetry in minute 6 were detected using a multiple linear regression model.
Results: The ODI score improved from 31 ± 18 to 17 ± 17 postoperatively (P = .001), while the walking distance (346 ± 111 m; P = .617) did not change significantly. Patients with greater improvement in the ODI score had greater postoperative improvement in gait symmetry of foot angles at push off in minute 6 of the 6MWT (R = .550; P = .012).
Conclusion: There was a large heterogeneity in gait asymmetry, ODI score and walking distance during the 6MWT. While overall patients had better ODI scores after surgery as one would expect, those with greater improvements in the clinical ODI score also had greater improvement in gait symmetry indicating improved gait stability. Improved gait symmetry after surgery may not only improve the ability to perform daily activities but may also prevent altered loads in some joints due to asymmetric gait.

P22

Minimally invasive surgery for adolescent idiopathic scoliosis: deformity correction and perioperative morbidity in 70 consecutive patients

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Introduction: Minimally invasive surgery (MIS) has been recently described for adolescent idiopathic scoliosis (AIS) with current data available based on a limited number of patients. Our primary aim was to evaluate deformity correction and perioperative morbidity in a larger group. Secondary aims included evaluation of operative time (ORT), estimated blood loss (EBL), length of stay (LOS) and additional complication.
Methods: Consecutive AIS patients treated with a MIS technique at 2 tertiary centers (Geneva and Lausanne University hospitals) from June 2013 to February 2016 were retrospectively included. Pre-operative patient and deformity characteristics, perioperative parameters, power of deformity correction, and complications were studied.
Results: 70 AIS patients were included (female = 62, age 15 ± 4.5 years, BMI 19.8 ± 5.4 kg/m^2). ORT averaged 337 ± 121 min. Preoperative major Cobb angle averaged 58.9 ± 12.6° and was significantly corrected to 17.7 ± 10.2° (69% curve correction, p <0.001). Preoperative T2-T12 kyphosis was 33.2 ± 13.7° and was significantly increased to 39.5 ± 11.4° (18% curve corrrection). Mean OR per level fused was 25 ± 5 min and decreased over the first 25 cases. Mean EBL was 346 ± 175 ml representing 36 ml ± 14 per level. Mean of screws used was 18.6 ± 4.1. Mean number of levels fused was 11.2 ± 4.9, representing 30 minutes of ORT per level. Average LOS was 4.6 ± 0.8 days. Perioperative (30 days) complication rate was 4.2%: 1 subcutaneous hematoma, 1 deep venous thrombosis, and 1 pulmonary complication. Five (7.1%) additional complications occurred in 5 patients at a mean follow-up of 2 years (41 patients have minimum 2 years follow-up): 1 superficial wound infection, 1 suture granuloma, and 3 delayed deep surgical site infections.
Conclusion: MIS for AIS is associated with a significant correction of spine deformity in frontal and sagittal planes, together with low EBL and short LOS. Perioperative complication rate seems to be similar to standard open technique. The longer-term safety of MIS procedure for AIS needs to be documented with further follow-up of a larger cohort.

P23

Variations of lumbopelvic alignment in standing, seated, and slumped postures in a cohort of asymptomatic adults: implications for lumbar fusion surgery

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Introduction: Studies of spinopelvic alignment in the standing posture have formed the basis of recommendations regarding the ideal lumbar fusion alignment to avoid postoperative complications. Only a few studies have investigated the effect of various sitting postures on alignment of the lumbar spine even though adults spend an increasingly larger proportion of their waking hours sitting in a chair at the office or at home. We asked the question: how do sitting postures alter the alignment of the lower lumbar spine, which is the most prevalent site of spinal fusions for painful degenerative conditions in adults.
Methods: Eleven asymptomatic volunteer subjects (10M/1F, 39 ± 12 years) consented to participate in the study, which was approved by the local institutional review board. Each subject was positioned inside an EOS machine and instructed to assume the following postures: (i) standing erect (P1), (ii) sitting erect (P2), and (iii) sitting slumped (P3). Subjects were instructed to maintain horizontal gaze by looking straight ahead in a full-length mirror mounted in front of the subjects while a full-length lateral radiograph was taken for each posture. All alignment parameters were compared between the three postures using paired t-tests (P1 vs. P2 vs. P3).
Results: As subjects transitioned from standing (P1) to sitting erect (P2), upper lumbar (L1-L3) lordosis did not change while L4-S1 lordosis significantly decreased, (28.8 to 17.4 degrees, p <0.001). Postural change from erect sitting to slumped sitting (P2 to P3) had the opposite effect: the L1-L3 segments underwent a significant alignment change, from 11.1 degrees of lordosis to 3.1 degrees of kyphosis (p <0.001); while L4-S1 lordosis did not significantly reduce (17.4 to 12.7 degrees lordosis, p = 0.1). The L3-L4 segment behaved similar to the lower two lumbar levels for transition from P1 to P2, and similar to upper lumbar levels when transitioning from P2 to P3.
Conclusions: L4-S1 lordosis significantly decreased when transitioning from standing to sitting. If fusion across L4-S1 is indicated, our observations suggest the sagittal alignment of the lower lumbar spine in the standing posture may not be considered as the gold standard for surgical reconstruction since it may put the proximal segments at risk of developing postfusion breakdown. Further exploration is warranted using a prospective study on patients with short fusions and taking into account compensation possibilities of individuals.

P24

Factors associated with having an indication for surgery in patients with adult spinal deformity (ASD)

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Introduction: The results of surgery for adult spinal deformity (ASD) are highly variable and suggest patient selection could be improved. Previous studies have investigated differences between groups of ASD patients receiving either surgery or conservative care, but not in relation to whether surgery was indicated or not; as such, patients refusing or unable to undergo surgery would have been grouped with those for whom no such indication existed, confounding the analyses. We sought to carry out a cross-sectional analysis of the presenting characteristics of patients with and without an indication for surgery, using data (N = 937) from an international multicenter ASD database.
Methods: The treating surgeon documented whether there was an indication for surgery or not; this was the dependent variable in multiple logistic regression analysis. Baseline variables were grouped into demographics, medical history, health-related quality of life (HRQoL), radiological, and neurologic parameters, with significant variables in each block being entered into the final model. The model's predicted probability of an indication was compared with the actual status (indication/no indication) for each patient. The area under the Receiver Operating Characteristics (ROC) curve (AUC) indicated model accuracy.
Results: 316 patients had a degenerative (DEGEN) etiology and 621, an idiopathic (IDIO). For DEGEN, worse Oswestry Disability Index scores (p <0.0001) and a lower degree of maximal kyphosis (p = 0.001) were the factors significantly associated with an indication for surgery. The corresponding variables for IDIO were lower age (p <0.0001), worse SRS self-image scores (p <0.0001), sagittal subluxation (p <0.0001), less lumbar lordosis (p <0.0001), a higher major Cobb angle (p = 0.005), no prior fusion surgery (p = 0.007), use of narcotics (p = 0.041) and prior infiltrations (p = 0.042). 81% DEGEN and 73% IDIO patients were correctly predicted, with ROC analysis showing good accuracy (DEGEN, AUC = 0.82; IDIO, AUC = 0.81; each p <0.0001).
Conclusion: For both etiologies, indicators of symptom severity (infiltration/medication use and/or HRQoL scores) and some radiographic parameters showed a strong statistical association with having an indication for surgery. Future studies of the model's prediction (indication/no indication) and the outcome of the actual treatment a patient receives (surgery/conservative) should reveal whether the predictors might help in selecting appropriate patients for surgery.

P25

Spectrum of perioperative morbidity and complications after spine surgery in a Swiss University Hospital setting

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Introduction: There is a broad spectrum of complications associated with spine surgeries, with differing incidences reported in the literature. While the majority of studies assess complications in the United States, fewer reports are available for European countries. The aim of the present study therefore was to assess the spectrum and incidence of perioperative complications and morbidity in the post-operative period after spine surgical procedures in a Swiss tertiary care setting.
Methods: Data on clinical and surgical details were collected for patients who consecutively underwent spine surgery in a Swiss

university hospital between 05/2014–12/2015. Special focus was set on the details of perioperative morbidity and the analysis of complications in the early postoperative setting (3 months).
Results: A total of 1009 patients who were consecutively operated on the spine, including 32.1% of revision surgeries, met the inclusion criteria. The average age at surgery was 60.9 ± 15.8 years, active smoking was documented in 35.9% of patients, opioid analgesics were used in 26.1%, and systemic steroids in 4.5%. Preoperative ASA assessment revealed an ASA class I in 19.5%, ASA class II in 55.7%, ASA class III in 23.3%, and ASA class IV in 1.5%. Average length of surgery was 145.5 ± 69.9 min, length of postoperative ICU stay was 7.7 ± 13.4 hours, and length of hospital stay 6.1 ± 3.6 days. The most commonly performed intervention was a lumbar decompression (52.2%), followed by lumbar spondylodesis (22.8%). Overall, 179 complications were documented, of which 119 were surgical (66.5%) and 60 medical complications (33.5%). The most common surgical complication was a relapse of symptoms (n = 33), followed by wound healing problems (n = 24), and implant-associated complications (n = 16). The most common medical complication was perioperative anemia (n = 18), followed by symptomatic electrolyte derailment (n = 10), and cardiac complications (n = 7).
Conclusions: With an aggressive definition of a complication as any kind of irregularity (including re-herniation for example), 12% of surgical and 6% of medical complications could be documented in a tertiary care setting, with around one third of surgeries conducted in previously operated patients. Only a classification that documents both surgical complexity and patients' medical status, and a standardized reporting system of complications will allow quantification of quality of care in different settings in the future.

P26

Tarlov cyst: a diagnostic of exclusion. A case report

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Background: Tarlov cysts were first described in 1938 as an incidental finding at autopsy. The cysts are usually diagnosed on MRI, which reveals the lesion arising from the sacral nerve root. Paulsen reported the incidence of Tarlov cysts as 4.6% in back pain patients (n = 500). Only 1% of back pain patients (n = 500) were symptomatic. The patient may present as low back pain, sciatica, coccydynia or cauda equina syndrome. Symptomatic sacral perineural cysts are uncommon and it is recommended to consider tarlov cyst as a diagnostic of exclusion, in opposition to the avascular necrosis of the femoral head which is more common.
Objectives: We report a case of a patient with voluminous bitaleral L5 and S1 Tarlov cyst, and right hip osteonecrosis to increase the awareness of this rare entity.
Study Design & Methods: A 57-year-old female, in good health, with a history of chronic low back pain since 20 years, presented suddently right buttock pain, low back pain and right inguinal fold pain for two months, with unability to walk and to sit down on the right buttock. The pain was not associated with specific time, posture or activity and it was not relieved by non steroidal antiinflammatory drugs (NSAID). X-ray of the lumbosacral spine revealed asymetric discopathy L5-S1 and L3-L4 (fig. 1). X-ray of the right hip did not revealed anything (fig. 2). We asked for an MRI of the spine: – Voluminous fluid-filled cystic lesion, arising from the fifth lombal nerve root on both side and measuring 1.2 cm in diameter (fig. 3), from the first sacral nerve root on both side and measuring 3.3 cm in diameter (fig. 4). The MRI also show a part of the hip and incidentaly we discovered: – Osteonecrosis Ficat 3 of the right femoral head (fig. 6).
Results: The patient was taken for a total hip arthroplasty, by anterior approach (Uncemented Stem SPS evolution, uncemented cup April, bearing couple ceramic-ceramic) (fig. 7). Patient appreciated relief of pain immediately after the surgery.
Conclusions: The current case show that even if we find a voluminous cysts we always have to eliminate other diagnosis (especially the frequent like osteonecrosis of the femoral head) and mostly in the case of unclear neurological perturbation. However in the case of our patient we discovered the hip osteoecrosis incidentally and in front of pain of the inguinal fold we should have request immediately an MRI of the the hip in addition to the spine MRI, even if she hadn't any risk factors.

P27

Risk factors for perioperative complications and morbidity in spine surgery: multivariate analysis of 1009 consecutive patients

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Introdution: There is a plethora of risk factors described to be associated with the occurrence of perioperative complications in the setting of spine surgery. In order to ensure comprehensive patient informed consent and comparability of quality of care, evidence-based identification of such risk factors is inevitable. The aim of the present study was to identify potential risk factors for peri- and early postoperative complications in the setting of spine surgeries in a large cohort of consecutive patients based on multivariate risk factor analyses. Preliminary results of multiple binary logistic regression models are presented.
Methods: Demographic, clinical, and surgical data on patients who consecutively underwent spine surgery at a single university hospital between 05/2014 and 12/2015 were analyzed with binary logistic regression models to assess risk factors for (a) hospital stay ≥10 days, (b) post-operative intensive care unit stay ≥24 hours, (c) blood loss >500 mL, and incidence of (d) a surgical or (e) medical complication in the early postoperative period.
Results: A total number of 1009 patients (F: 481, M: 528) with an average age at surgery of 60.9 ± 15.7 years underwent a primary (67.9%) or a revision (32.1%) spinal surgery. Binary logistic regression model for (a) a hospital stay >10 days identified surgery at the thoracolumbar junction, intensive care unit (ICU) stay, occurrence of surgical complications, revision surgery, and CRP as associated risk factors. Risk factors for (b) a postoperative ICU stay >24 hours were surgery involving the sacrum, creatinine and ASA class ≥3. Risk factors for (c) blood loss >500 mL were spondylodesis, surgery involving the lumbosacral spine, age, and length of surgery. Parameters associated with (d) a surgical complication were spondylodesis, male gender, and length of hospitalization, and for (e) a medical complication: high creatinine, blood loss, and steroid use.
Conclusions: Based on the herein presented results, a higher degree of surgical invasiveness as well as severity of medical comorbidities seem to be significantly associated with an increased risk for perioperative morbidity and/or early postoperative complications. A system for standardized quantification of complexity of a surgical procedure and severity of medical comorbidities is needed for patient risk estimation. More in depth analyzes are subject of further research.

P28

Structural validity of the SRS-22 questionnaire in patients with adult spinal deformity

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Introduction: Designed for patients with adolescent idiopathic scoliosis, the Scoliosis Research Society (SRS) questionnaire is now used as the outcome instrument of choice in patients with Adult Spinal Deformity (ASD). No studies have confirmed the four-factor structure (pain, function, self-image, mental health) in ASD or evaluated this in different contexts. We sought to evaluate the invariance of the factor structure of SRS-22 across different languages, age-groups, ASD etiologies, and times of assessment.
Methods: Confirmatory factor analyses (CFA) was performed on the 20 non-management items of the SRS-22 from 428 Spanish, 229 Turkish, 95 French, 195 German and 245 American ASD patients. Item-loading invariance was compared across different languages, age groups, etiologies and times of assessment (baseline, follow-up). A separate sample of 772 American SRS-22 data from surgical ASD patients was used for cross-validation.
Results: The SRS-22 factor structure fitted significantly better to the proposed four-factor solution than to a unifactorial solution. However, three items Q14 (self-image; "back affects personal relationships"), Q15 (function; "financial difficulties because of back"), and Q17 (pain; "days off in last 3 months") consistently showed weak item loadings within their factors across the language versions and in both baseline and follow-up datasets. Other items e.g. Q8 («back pain at rest), Q11 ("medication use"), and Q10 ("trunk appearance") showed weak items loadings in some languages only. A trimmed SRS (SRS-16) that used

the 4 least problematic items in each of the 4 domains yielded better-fitting models across the languages, but equivalence was still not reached; there was, however, equivalence of item-loading with respect to treatment (surgery vs nonop), time of assessment (baseline vs 12 mo FU), and etiology (degenerative vs idiopathic), though not age (</≥ 50y). All findings were confirmed in the cross-validation sample.
Conclusion: We recommend removal of the 4 less-well-fitting items of the SRS-22, together with adaptation and standardization of other items across language versions, to provide an improved 16-item version of the instrument. Since factorial invariance of an instrument under different conditions is essential to allow for comparisons across studies, this should provide for a more valid instrument in future multicentre outcome studies in ASD.

P29

Is ORIF the better treatment for periprosthetic Vancouver type B2 femur fractures?

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Introduction: There is some evidence, that stem retention with internal fixation might be a superior strategy, compared to stem exchange in periprosthetic Vancouver type B2 fractures. The goal of the here presented study was to investigate intra- and perioperative complications within these two alternate treatment concepts.
Methods: In a retrospective, single-center study 53 patients (36 female, 17 male), median age 79 years (range 51–93) who underwent surgery for periprosthetic Vancouver type B2 femur fracture between 01/2004 to 06/2016 were included. 26 patients (16 female, 10 male) median age 79.5 years (range 51–93) underwent stem revision (SR), while in 27 patients (20 female, 7 male) mean age 79 years (range, 56– 93) stem retention with internal fixation was performed. American Society of Anesthesiologists (ASA) classification, surgical time, intraoperative blood loss, required erythrocyte concentrates (EC), intra- and postoperative complications, length of hospital stay and need for further surgery were recorded.
Results: ASA-classification and duration of hospital stay were not different in the two groups. Surgical time in the ORIF-group was 124.5 minutes (range, 75–194) vs. 150 minutes (range, 96–241) (p = 0.0187). Blood loss was 700 mL (range, 250–5200) in the SR-group compared to 500 mL (range, 50–1500) (p = 0.0422). Odds ratio to have a complication in the stem revision group (11 patients (46%) vs. 6 (22%); p = 0.1581) was 2.449 (95% CI: 0.7654–7.668). Odds ratio for revision surgery (4 patients (15%) vs. 3 (11%); p = 0.704) was 1.455 (95 % CI: 0.355–6.24). In one (4%) patient, ORIF failed and additional surgery was required. Odds ratio to die within first 12 months (5 patients (19%) vs. 1 (4%); p = 0.1003) was 6.19 (95% CI 0.6705–57.15) after stem revision.
Conclusions: Our results show significant lower surgical time, less blood loss, fewer required EC and a lower major complication rate in the ORIF group compared to the stem revision group. ORIF seems to be an alternate concept in the treatment of Vancouver type B2 fractures and our results suggest that elderly patients could benefit from this treatment method in terms of lower peri- and postoperative complication rate.

P30

The direct anterior approach for total hip arthroplasty in the severe obese patient. Is it a reliable option for patients with a BMI >35 kg/m²?

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Introduction: Severe obese patients (BMI >35 kg/m²) requiring total hip arthroplasty (THA) are not considered good candidates for direct anterior approach (DAA) as excessive abdominal fat tissue can impede surgery thus increasing the potential for complications. The advantages of the DAA in THA are well known, however the concerns about applying these techniques in obese patients remain controversial. The aim of this study, was to determine if the DAA is a reliable option in severe obese patients in terms of complications and outcome.
Methods: In this retrospective cohort study we included 141 patients (80 female, 61 male) with a median BMI of 42 kg/m² (range 35–56) who underwent primary THA through a DAA in our department from January 2009 to December 2015. Median age was 69 years (range, 45–91) and median follow-up time 3.2 years (range, 1–5). As control group acted 285 patients (129 female, 156 male), with a median BMI of 23.6 kg/m² (range 20–25) and median age of 72y (range 61–94) who had surgery in the same time period. Median follow up time was 2.6y (range 1–5). Intraoperative data, peri- and postoperative complications, radiographic values and hip function (Harris Hip Score) were assessed.
Results: In the severe obese group 10 hip infections (7.8%) were recorded until last follow up time. 20 patients required revision surgery (14%). Median hospital stay was 13.2 days. 3 patients deceased during follow up. In one case death was related to hip infection. The median Harris Hip score (HHS) improved from 61 (range 35–70) to 87 points (range 74–100). The infection rate in the control group was 1.7%. 12 patients required revision surgery (4.2%). Median hospital stay was 6.2 days. The median HHS improved from 62 (range 40–74) to 91 points (range 78–100). 4 patients deceased during follow up. No death was linked to the surgical treatment. No dislocation was observed during follow up time in both groups.
Conclusion: Our data suggest that severe obese patients have significantly higher infection rates compared to non obese patients. However, compared to literature our infection rates with the DAA are comparable to standard more extensive approaches. Severe obese patients can still profit from the benefits of DAA as do non-obese patients. The results of this study should be further investigated to assess long-term effects.

P31

Modified extended trochanteric osteotomy for the treatment of Vancouver B2/B3 periprosthetic fractures of the femur

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Background: Femoral component revision is the treatment of choice for Vancouver type B2/3 periprosthetic femur fractures (PFF). The purpose of this study was to report the clinical outcome of revision total hip arthroplasty (THA) with the use of a modified extended trochanteric osteotomy (ETO) in PFF treatment.
Methods: 43 cases between 2000 and 2014 were analyzed. Clinical and radiographic evaluation was performed with a mean follow up of 40 months. Patient survival following revision surgery, complications, radiographic outcomes as well as quality of life and hip function were assessed.
Results: Merle d'Aubignè and Postel score averaged 15 and mean postoperative Harris hip score was 70. Radiographic evaluation revealed that the ETO and fractures healed in all but one patient within 9 months. Component stability and apparent osseointegration were not coincident with healing of the osteotomy and fracture sites proximal to the inserted stem. Six patients (15%) developed postoperative complications, these included: one non-union with progressive subsidence, two hip dislocations, two deep infections, and one breakage of the modular junction of the revision stem.
Conclusion: The modified ETO with a lateral approach to the hip for the treatment of PFF is compatible with fracture healing, a low dislocation rate and good clinical results. However, component stability and apparent osseointegration are coincident with fracture healing only in the distal aspect of the inserted stem. Absence of proximal osseointegration might lead to poor osseous support resulting in inadequate fatigue strength at the junction of the dual modular revision stem.

P32

Predictors and patterns of elevated blood metal ions levels after metal-on-metal total hip arthroplasty

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Introduction: Risk factors for elevated blood metal ion levels have been reported after large metal-on-metal (MoM) total hip Arthroplasty (THA). However, the literature on risk factors after small head MoM THA is sparse and little is known about the pattern of blood ion levels over time. Our objectives were to determine predictors of elevated blood metal ion levels after small head MoM THAs and to assess the pattern of blood metal ion levels in both small and large head THAs over time.
Methods: All primary MoM THAs with postoperative blood metal ion (cobalt and chromium) concentration performed between 11/1998 and

03/2010 were included. The cut off for blood cobalt level considered as elevated was ≥2 ug/l. We stratified the MoM THAs in 2 groups, small (≤28 mm) vs. large (>28 mm) head THAs. The following potential predictors were evaluated: age, sex, BMI, smoking status, ASA score, Charnley score, aspirin use, diagnosis, bilateral MoM THA, stem type (cemented vs. not), side operated, cup diameter and inclination. To assess the pattern of blood metal ion levels over time, only unilateral MoM THA with at least two cobalt measurements were included. Logistic regression was used for the analysis.
Results: Overall, 447 MoM THAs were included (mean age 58.5 years, 44.5% women), 355 with small heads (group 1) and 92 with large heads (group 2). Group 1 was older (mean age 61.1 years vs. 48.7) and included more women (49% vs. 28%). Median cobalt value at first measure was 1.2 ug/l (interquartile range, IQR, 0.8–1.9) for group 1 and 2.2 ug/l (IQR 1.2–6.1) for group 2. In the univariate analysis female gender, never-smoking, ASA 3-4, bilateral MoM THA and aspirin use were significantly associated with increased cobalt levels in the small head group. In the multivariate analysis bilateral MoM THA, never-smoking, aspirin use, and ASA 3-4 remained significant predictors ($p < 0.2$). 48 unilateral THAs had a second cobalt measure. Cobalt level was ≥2 ug/l in 8 patients (23.6%) in the small and 9 (64%) in the large head group. Overall 6 patients changed the category (< vs. ≥2 ug/l), 5 moved to above and one moved to below 2 ug/l, while in 41 THAs (85.4%) cobalt levels remained stable.
Conclusion: Bilateral MoM THA, aspirin use and higher ASA score were associated with higher cobalt levels in the small head MoM group. Ever-smoking was associated with lower cobalt levels. The patterns of cobalt levels appeared to be stable in a high proportion of THAs after 5 years postoperative.

P33

Radiographic signs or hip pain 5 years after THA: useful in predicting future revision?

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Introduction: Substantial effort from industry and the research community is directed at improving implant longevity. To identify early and reliable predictors of late failure is essential for both implant safety and innovation. Our objective was to assess the relation between radiographic signs or hip pain at 5yrs postoperative and future revision for aseptic loosening up to 20yrs postoperative.
Methods: We included all primary THAs operated between 1996–2011 (same uncemented cup, PE-ceramic bearing, 28 mm head, cemented stem) for whom baseline and follow-up radiographs were available. At the 5-year clinical visit radiographic signs assessed were: femoral linear/focal osteolysis and/or stem migration ≥2 mm. Pain was evaluated with Harris Hip score pain sub-scale (no/occasional vs. mild-severe). Sensitivity, specificity and relative risk (RR, 95%CI) were calculated.
Results: 1054 THAs were included, mean age 70.9 yrs, 62% women. Median follow-up was 14.4 yrs (range 5.1–20.9 yrs). Over that period 287 patients died (27.2%). Radiographic analysis at 5 years revealed 55 cases with femoral osteolysis (5.2%), 112 with stem migration ≥2 mm (10.6%), and 158 (15%) had at least one radiographic sign. Twenty-one (2.0%) revisions for aseptic loosening (stem only or total) were performed between 5.2 and 18.8 yrs postoperative (median 13 yrs). At 5 yrs, 14 of the 21 patients later revised had osteolysis/stem migration (Sensitivity 66%, Specificity 88%). RR for future revision in patients with vs. without radiographic signs was 11.3 (95%CI 4.8–29.5). In patients under 65 years of age 12 of the 15 patients later revised in this age group had osteolysis/stem migration (Sensitivity 80%, Specificity 88%). RR for future revision was 19.2 (95%CI 6.5–81.5). At the 5-year clinical visit, 120 of the 1054 THA patients (11.3%) reported mild to severe hip pain. Among the 21 patients later revised 7 reported hip pain (Sensitivity 33%, Specificity 88%) at 5 years. RR for future revision in patients with vs. without pain was 3.7 (95%CI 1.4–8.7).
Conclusion: In a prosthesis with known excellent long-term survival radiographic signs were already present 5 years postoperative in two-third of the patients revised for aseptic loosening over the following 14 years. This proportion increased to 80% in patients under 65 years of age. Pain was not a useful predictor of long-term failure.

P34

Does the anterior approach to the hip jeopardize vascularisation of the proximal femur?

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Introduction: Branches of the lateral femoral circumflex artery (LCFA) provide the main blood supply of the proximal metaphysis of the femur. This study aims at determining if a surgical approach to the hip influences the blood supply of the trochanter major, as can be determined in digital subtraction femoral arteriography. This is particularly relevant as the anterior approach becomes more popular for hip arthroplasty, and as it requires ligation of the ascending branch of the LCFA.
Methods: We reviewed 1280 femoral digital subtraction arteriograms performed for vascular indications between 30.06.2014 and 30.06.2016. Exclusion criteria were relevant vascular disease of the femoral vessels and previous vascular interventions or surgery. Arteriograms with insufficient field of view or without filling of the LFCA were excluded too. The recruited cases were split into 4 groups: Status after hip surgery through an anterior approach (n = 10), respectively a lateral approach (n = 31), status after fracture fixation of the proximal femur (n = 5), and a control group of 50 continuous patients without previous surgery. Time until perfusion of the greater trochanter was noted as a number of frames after injection of the contrast media into the deep femoral artery (DFA). The frame rate was standardised.
Results: The number of frames until the trochanter major is supplied with contrast was 3.6 ± 0.9 (mean+/-SD) in patients without hip surgery, after fracture fixation 4.8 ± 1.5, after a lateral approach 5.2 ± 1.1, while it was 7.0 ± 1.9 in patients who had underwent an anterior approach. While there was a statistically significant delay in all operated patients ($p < 0.0001$) compared to the control group, there mainly was a significant increase in the number of frames until perfusion of the greater trochanter in the group of the anterior approach ($p = 0.0004$) compared to all other operated cases.
Conclusion: After an anterior approach to the hip, perfusion of the proximal femur is delayed, compared to control cases and hip surgery through another approach. The clinical relevance of this finding still needs to be determined. However, early femoral complications after hip arthroplasty might require a transfemoral approach, particularly fractures. This might critically jeopardize blood supply to the proximal femur, as the trochanteric branch coming from the medial femoral circumflex artery is the interrupted too.

P36

Excellent long-term results of the Müller acetabular reinforcement ring in primary cup revision

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Introduction: The original Müller acetabular reinforcement ring (ARR) was developed for acetabular revisions with small cavitary and/or segmental defects or when acetabular bone quality is poor. Long-term data for this device are scarce. We therefore investigated long-term survival and radiological results for revision THA using the ARR.
Methods: Between 01/1984 and 12/2005, 259 consecutive primary acetabular revision using an original ARR were performed in 245 patients. The mean follow-up time was 10 (0–27) years, 8 hips were lost to follow-up. For survival analysis, we investigated 259 hips and the end of the follow-up was defined either by the date of revision, date of death, or the last patient contact date with implant still in situ. Radiological assessment was performed for 90 hips with a radiological follow-up of a minimum of 10 years. It included evaluation of osteolysis, migration and loosening.
Results: 16 ARR were re-revised: 8 for aseptic loosening, 6 combined with the stem, 6 for infection, 1 due to mal-positioning of the cup and 1 for suspected infection. The cumulative re-revision rate for all components, for any reason, at 20 years was 16 (95% CI: 10–23), while for the ARR only it was 11% (95% CI: 5–17) for any reason and 6% (95% CI: 2–11) for aseptic loosening. 21 (23%) of the 90 radiological examined ARR had radiological changes: 12 showed isolated osteolysis but were not loose. 9 ARRs were determined radiologically loose on follow-up, 5 of them had been revised.
Conclusion: Our data suggests that the long-term survival of the ARR in primary acetabular revision is excellent.

P37

Internal hemipelvectomy and partial sacrum resection in a patient with pelvic bone hydatidosis. A case report

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Introduction: Most hydatid cysts occur in the liver or in the lung. Hydatidosis of bone is rare and accounts for only 0.5 to 4% of all locations. The only curative treatment is surgery. We report a case of hydatid disease involving the entire left pelvis, hip joint and left sacrum.
Case presentation: A 29 years old male patient presented with limping and left hip pain. The medical history revealed the diagnosis of a tumour-like mass of the left supraacetabular region 3 years before. Open biopsy at that time confirmed a localized cystic echinococcus infection. Two surgical interventions with supraacetabular tumour excision and following anthelmintic therapy were performed. Despite progressive load related pain, further examinations in the country of origin were reported as normal. At first presentation at our institution, plain radiography revealed extensive osteolytic lesions at the left iliac bone and acetabulum together with degenerative changes of the hip joint. CT and MRI showed severe bone destruction of the whole left hemipelvis extending to the sacroiliac joint with involvement of the neuroforamina S1 and S2 and the surrounding intra- and extrapelvic soft tissues. After positive serological testing and initiation of an antihelmintic therapy an internal left hemipelvectomy together with a partial transforaminal sacrum resection was performed. Additional proximal femur resection was necessary due to hip joint involvement. During surgery, the adjacent tissue was protected with 20% NaCl solution. Due to extensive bone loss and the remaining unprotected nerves of the lower limb after surgery, second stage prosthetic procedure was deemed impossible. The remaining pelvitrochanteric muscles were fixed to the abdominal wall in a mitre-like fashion allowing limb control.
Results: The patient showed pain free and fluent ambulation using two crutches in the postoperative course. MRI examination 6 months postoperatively showed no evidence of local recurrence.
Conclusion: Hydatide osteopathy is an infiltrating, progressive disease. Surgery in combination with pre- and postoperative antihelmintic therapy is the only curative treatment. Early diagnosis helps in the eradication and salvage of the bone. The treatment remains challenging with the potential of functional loss and local recurrence rates reported up to 17%.

P38

MICHA – a minimal invasive capsulotomy in hip arthroscopy

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Introduction: In the last decade hip arthroscopy has become very popular in the treatment of femoroacetabular impingement. T-shaped opening or partial resection of the capsule are widely used to appropriately visualise the neck or the acetabular rim. In this procedure the iliofemoral ligament, the strongest ligament of our body, could be severely damaged, resulting in painful iatrogenic hip instability. This may be of high significance in athletes or in cases of FAI combined with gerneral laxity or borderline dysplasia.
Method: The iliofemoral ligament can not be seen from inside the articulation because of the synovial layer. Starting from our extraarticular approach, published in 2010, the ligament is identified by careful dissection of some superficial circular fibres. Capsulotomy ist carried out along the superior border of the superior bundle of the iliofemoral ligament. If a rim trimming and a refixation of the labrum or cartilage is necessary, the deep fibres of the capsule may be released from the acetabular rim. At the end of the procedure the capsule is completely closed by 2–4 sutures. In cases of laxity capsular plication can be performed.
Results: We studied our first 100 cases, operated between April 2015 and April 2016 by a single surgeon. 99 of them had a femoral neck plasty, 47 a rim trimming and labrum refixation. In 22 cases acetabular microfracturing has been done. Median duration of the operation was 128 minutes (83–225), in the first 20 cases the median was 134 and in the last 20 cases 126 minutes. There were no major complications, but in two cases superficial skin erosions in the groin have been observed. In 81 patients the procedure could be performed through a single longitudinal capsulotomy, in 3 cases an additional short incision, in 12 cases an L-shaped and in 4 cases a T-shaped capsulotomy and even partial resection of the capsule was performed. In these 4 cases we could not close the cap-sule completely. The goal of operation has been reached in all cases. There were no revisions done so far.
Conclusion: In the majority of cases our MICHA-technique allows a iliofemoral ligament sparing capsulotomy to enter the hip. There is steep learning curve, but the described technique allows for a minimal inva-sive arthroscopic approach to all compartements and most of the pathologies of the hip.

P39

Operative treatment of anterior dislocation in the obturator foramen with associated femoral head and acetabular medial wall fractures: A case report

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Objectives: Traumatic anterior dislocation of the hip joints is a rare condition. Thompson and Epstein described an incidence of 9% of all hip dislocations. Dislocations in the obturator foramen are seen in 6% of all hip dislocations. In up to 75% of the cases associated injuries in the ipsilateral acetabulum or proximal femur are present.
Methods: Clinical outcomes are showed by clinical investigation and scoring by the harris hip score. Radiological outcome was noted by plane radiographs, CT-scan and MRI.
Results: We report a case of an anterior dislocation in the obturator foramen with associated femoral head and acetabular medial wall fractures (Grad IV Stewart and Milford, and Typ V Levin). The patient was a 22 years old man who was injured in a ski accident on march 2011. Clinical and radiographic examination showed a dislocation of the right hip on the obturator foramen, with an medial wall fracture and an femoral head impression fracture like Hill-Sachs. In addition he showed multiples spine fractures (Typ B3 of Th 5 and 6, and apophysis avulsion of the left processus transversus in L2 and L3), an open olecranon fracture on the right elbow (AO 21-B1, Gustillo Grade 2) and a closed scapular fracture. First trauma care was made in a peripheral hospital with closed reduction of the hip dislocation and ORIF of the olecranon fracture and the patient was transferred in our hospital were a open revision of the right hip was done (17 days after trauma). The senior author performed an ORIF of the medial wall with osteosuture and refixation of the labrum-capsular complex with 3 bone anchor through a Kocher-Langenbeck- trochanter flip access. An inter-trochanteric closed wedge valgus osteotomy were performed with internal de-rotation to bring the femoral head lesion out of the weight bearing center and (after adequate shaping) the wedge was used as an autologous bone graft for the reconstruction of the femoral head and fixed with two 2 mm traction screws. Osteotomy was finally fixed with a blade plate.
Conclusions: We wants to present ours clinical and radiological midterm results at the follow-up end of 5 years:
The patient showed an excellent clinical outcome and a partial revascularization of the bone graft in the femoral head showed in MRI examination.

P40

The external obturator footprint as a landmark in total hip arthroplasty through a direct anterior approach: CT-based analysis in 200 patients

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Background: Anatomical landmarks for templating of total hip arthroplasty (THA) that are visible both during surgery and on the pre-operative radiograph are rare. If surgery is performed through a direct anterior approach the external obturator tendon (EO) is consistently visible, particularly the cranial part of its insertion. To use this point as a reference the exact position and dimensions of the footprint needs to be known.
Aim: First, to determine the location and dimension of the EO footprint on ap pelvis radiographs by correlating the EO anatomy in CT scans with conventional radiographs. Second, measure the precision with which the EO-footprint on pelvic radiographs can be determined on standard radiographs.
Methods: Pelvic CT scans of 200 patients were analyzed. Scans of patients <18 yrs or after previous hip surgeries were excluded. The EO tendon was identified in the coronal plane; the height of its footprint, and its distance to the tip of the greater trochanter was measured and identified on virtual radiographs. The EO footprint was classified as “grooved” or “flat” depending on its appearance in the sagittal plane. Further, the distance between the EO footprint and the anatomical axis of the femoral diaphysis was measured. The EO footprints were

marked on plain x-rays by two readers in a subset of 50 patients and transferred to the respective CT scan to compare it to its true position.
Results: The EO tendon was visible on all scans. The cranio-caudal dimension of the footprint was 6.4 ± 1.4 mm (range 3.0 to 11.8). Its distance to the tip of the greater trochanter was 16.0 ± 3.1 mm (range 10.1 to 29.2). In the axial plane, the distance of the EO footprint to the anatomical axis of the femur was 5.2 ± 3.7 mm (range –5.6 to 14.5). The EO footprint was grooved in 157 cases (78.5%) and flat in 43 cases (21.5%). There was no difference between the mean error (difference between x-rays and CT scan) between the two raters (0.3, –0.06 to 0.6 mm; p = 0.105; intraclass correlation coefficient 0.84).
Conclusion: The footprint of the EO tendon on the greater trochanter is consistently visible on CT scans and on virtual radiographs. The EO footprint can be localized on plain x-rays with an acceptable accuracy. As the variability of the footprint dimension is small, this structure might be a useful landmark in THA, particularly when performed through a direct anterior approach.

P41

Proximal bone restoration patterns in revision THA using distally fixed modular tapered titanium stems and an extended trochanteric osteotomy approach.

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Background: Mechanical failure at the modular junction of femoral revision stems is an uncommon but serious complication in revision total hip arthroplasty (THA). The lack of adequate osseous support to the proximal component, especially in cases of an extended trochanteric osteotomy (ETO) approach, is considered one of the risk factors for stem failure. In the current study, we analyse proximal bone regeneration patterns in patients undergoing revision THA for aseptic stem loosening through an ETO approach using an uncemented dual modular, tapered titanium stem.
Methods: We reviewed clinical and radiographic charts prior and immediately after surgery as well as 2, 6, 12 and 24 months postoperatively in all patients treated from 2000–2015. Radiographic analysis consisted of preoperative bone loss assessment according to Gross classification system. The femur was divided according to the Gruen zones. Formation of new cancellous bone as well as presence of direct osseous contact to the stem was noted in a timely manner for each Gruen zone. The presence of osseous support of the proximal modular component as well as at the level of the modular junction was examined.
Results: 54 patients with a median age of 73 ± 11 years at revision THA were included. All patients showed restoration of proximal bone mass at final follow up examination. Radiographically visible new bone formation was first seen in gruen zones 13, 6, 2 and 9, emphasising that bone regeneration occurs in a distal to proximal direction. Cases with longer proximal components of the dual modular revision stem had a trend towards earlier osseous support at the modular junction than cases where a short proximal component was used. Overall, 75% of patients showed direct bony contact at the modular junction two years after surgery, while osseous support to the proximal component was observed in 81% of patients. No failure at the modular junction was observed.
Conclusion: Restoration of proximal bone in revision THA with transfemoral implanted, dual modular tapered stems seems to occur in a distal to proximal direction. Two years after surgery, radiologic signs of bony support to the modular junction and the proximal modular component can be expected in a high percentage of cases. However, the use of proximal modular components of a shorter size might lengthen time until osseous support to the component is accomplished and could possibly affect the risk of mechanical failure at the modular junction.

P42

Bikini skin crease incision for direct anterior approach: clinical and radiographic mid-term results

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Introduction: The direct anterior approach (DAA) has traditionally been performed through a longitudinal incision in line with tensor fascia lata, however, this does not follow anatomic skin cleavage lines, which may result in increased tension at the skin edges, inferior wound healing, poor scar cosmesis, and subjective patient discomfort. The purposes of this study are to describe patient functional outcomes and radiographic outcomes of a modified short oblique “bikini” incision for DAA compared to a traditional longitudinal incision.
Methods: 964 patients undergoing total hip arthroplasty using DAA (49% male, 51% female; 59% with longitudinal incision, 41% bikini incision) completed 2 to 4 years after surgery a follow-up questionnaire including the Oxford Hip Score (OHS), the University of North Carolina 4P scar scale (UNC4P), and two items assessing aesthetic appearance and symptoms of numbness. Stem positioning and the rates of radiographic heterotopic ossification were also assessed.
Results: According to the clinical scar score (UNC4P) total score were significantly (p <0.001; effect size 0.2) better in the Bikini [0.2 (SD 0.8)] compared the longitudinal group [0.4 (1.0)]. The patients of both groups were satisfied or very satisfied (about 99%). However, the proportion of very satisfied patients was higher (p <0.001) in the Bikini compared to the longitudinal group. The proportion of patients reporting numbness in the scar was higher (p <0.001) in the longitudinal compared to the Bikini group (14.5 versus 7.5%, respectively). The OHS was higher in the Bikini group than the longitudinal incision group (p = 0.013; effect size 0.15). Radiographic cup abduction angles were similar between the Bikini and longitudinal incision groups (Bikini: 41.0 degrees; standard deviation [SD] 5.3 (n = 87); Longitudinal: 41.2 degrees; SD 5.0 (n = 113); Diff. –0.2 (–1.7 to 1.2), p = 0.740). There were no differences in stem position between the two groups (% varus positioning: 11.5% in Bikini versus 9.7% in Longitudinal group; p = 0.43). Rates of radiographic heterotopic ossification were not different between the two groups.
Conclusion: The bikini incision resulted in improvements of patient satisfaction in relation to the scar. Our study also showed that a short oblique “bikini” skin crease incision for the DAA could be performed safely without compromising implant positioning or increasing symptoms suggesting lateral femoral cutaneous nerve dysesthesia.

P43

A method for a C-arm controlled intraoperative evaluation of the hip tilt for total endoprosthesis implantation

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Introduction: For a successful total hip prosthesis implantation the physiologic alignment of the acetabular cup is inevitably. The crucial impact is the correct inclination and anteversion of the acetabular cup. Differences in the angle of orientation of this load-bearing part leads commonly to postoperative problems in hip-luxation. Here, the anterior movement of the femoral implant is the most documented problem. Therefore, this study evaluates the radiologic projection of the obturator foramen in regards to the retroversion/anteversion tilt positions of the pelvis in order to define the angle intraoperatively.
Methods: To perform the study, a custom designed device simulating an inclined plane was used to simulate the tilt of isolated, formalin-fixed pelvic samples in 5° steps. After an anatomical orientation of the samples on the device, C-arm as well as CT-images were obtained in predefined tilts. The retrieved projections were evaluated with the image analysing Software VG Studio Max® 2.2 and the relation of the defined longest diameter to the longest perpendicular extension was assessed.
Results: The results reveal that a C-arm centered projection of the unilateral hip joint depicts the obturator foramen with different dimensions of the longest paramedian diameter and its perpendicular extension in a constant relation in accordance to the pelvic tilt. The defined measurement technique proved to be more concise and reliable in comparison to C-arm centered projections of the bilateral hip joint and defines a mathematical relation as well as a high Coefficient of determination. Via tilt angles of the pelvic bones from 25° retroversion to 25° anteversion and the mathematical analysis of the defined diameters, we found the angle of pelvic tilt (x) to be in relation to the ratio (y) of the longest paramedian diameter to the perpendicular extension to be:
$y = –0.0216x + 1.09$ (right side)
$y = –0.0232x + 1.16$ (left side)
The raised intra- and interobserver reliability of the confidence intervals (2σ) showed average ratios of 2.7%.
Conclusion: In order to realize a significant relationship of importance for the hip-TEP implantation during orthopaedic procedures, follow-up studies presenting the results of a larger and statistically significant sample collection are already in preparation. A confirmation of the found linear function could be used to determine the deviation of the pelvic tilt for a precise calculation and alignment of the acetabular cup orientation.

P44

The incision index: a decision tool for open vs. arthroscopic treatment of femoroacetabular impingement

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Introduction: Surgical hip dislocation (SHD) and hip arthroscopy (HAS) both represent commonly applied approaches for correction of femoroacetabular impingement (FAI) of the hip. Although both procedures proved success, there is an absence of consensus regarding surgical choice. The aim of this study was to define patients likely to benefit from either procedure based on a multivariate analysis.
Patients and method: The cohort included 29 patients (29 hips) undergoing SHD and 53 patients (56 hips) undergoing HAS. Pre- and postoperative radiographic parameters and clinical scores 2 years postoperatively were evaluated, and a multivariate model utilized to determine factors influencing surgical decision. A formula was generated and tested using receiver operated curves (ROC).
Results: The preoperative lateral-centre-edge angle (LCE) and the alpha angle were found to be higher in patients undergoing SHD. More correction of both angles was greater with SHD. Despite greater correction, the alpha angle remained higher in the SHD group. There was no difference between the two groups regarding postoperative LCE and clinical follow up scores 2 years postoperatively. Based on the comparable outcome between groups, we evolved a formula (incision index) defining whether a hip would undergo SHD or HAS in this cohort: In hips with a positive cross over sign: X = alpha angle + (LCE*2). In hips with a negative cross over sign: X = alpha angle + (LCE*1.5). Using 120 as cut off, the Roc-Curve showed a sensitivity of 0.897 and a specificity of 0.786.
Discussion: In the HAS group, adequate correction of LCE and alpha angle were achieve in 95% of hips with an incision index <120, but only in two thirds of hips with a high index >120, where the LCE was undercorrected. As the average intraoperative correction of LCE was higher in the SHD group, these hips may have benefited from open surgery.
Conclusion: The incision index may act as a tool to aid the decision whether HAS is sufficient as a treatment option or whether more invasive open surgery would be necessary in a patient with symptomatic FAI.

P45

Do patients increase sports and leisure time physical activity after total joint replacement? A prospective evaluation

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Aim of the study was 1) to determine levels of sports and activity participation within the year before total joint replacement (TJR) and within the year after TJR, 2) to assess preoperative expectations regarding sports/leisure time activities, and 3) to analyze any effects of expectations and activity levels on the 1-year outcome of TJR based on patient-reported outcome measure (PROM) values and satisfaction rates. This prospective study included 380 patients with osteoarthritis undergoing THA (n = 193) or TKA (n = 187). The patients completed different PROMs (Oxford Scores, WOMAC, EQ-5D, UCLA activity scale) before and at 12 months after TJR. An additional questionnaire inquired for the participation in different activities and sports within the last 12 months before (baseline) and after surgery (follow-up). At baseline, the patients also stated if they expect to participate in the different activities after surgery and if they consider participation in any specific activity as important. At follow-up, the patients rated their overall satisfaction with the result of surgery. Overall, 86.6% of the patients were active at least occasionally before surgery and 87.4% were so at follow-up. There were no differences between THA and TKA patients. Active patients indicated participation in a mean of 4.7 different activities before surgery and in 4.0 at 12 months after TJR ($P < 0.01$). The most frequent activities before and after surgery were hiking, swimming, cycling, fitness training, gymnastics and downhill skiing. Only 7 mainly low-impact activities were rated as important by more than 20% of the patients, another six disciplines were positively rated by 10–20%. Patients who were regularly active had significantly higher score values on most PROMs than their inactive counterparts. There were no differences between regularly active and inactive patients for overall satisfaction (93.8% versus 94.6% satisfied or very satisfied). Almost 90% of patients undergoing TJR were physically active in the year before surgery, and the same large proportion was active postoperatively. There were no substantial differences between THA and TKA patients except a trend towards engagement in more activities with higher impact in the hip group. Expectations were almost exclusively linked to activities with lower impact. Regularly sports-active patients had higher PROM values than their inactive counterparts, but activity-participation was not correlated with overall satisfaction.

P46

Early mobilization program after primary THA, a prospective case series in a swiss regional hospital

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Introduction: In recent years, a trend towards early rehabilitation program (EMP) after elective primary total hip arthroplasty (THA) was noted. Recent studies suggest that it could reduce length of stay (LOS) at hospital and decrease the rate of post operative complications (deep venous thrombosis, pulmonary and urinary track infections). The aim of the study was to evaluate this multimodal approach combining patient education, surgical and anesthetic technique, post operative analgesia and rehabilitation in a swiss regional hospital.
Methods: We prospectively collected the data of 20 consecutive patients undergoing primary THA in the early rehabilitation program. Exclusion criteria were patient not amenable for home discharge at pre-surgical visit. All surgeries were performed by a direct anterior approach, by a single surgeon, at a regional hospital in Swizterland. All patients received local anesthetic infiltration during surgical closure. After surgery all patient had an early mobilization with physiotherapist assistance. The two main outcomes were readiness for discharge (RFD) and effective LOS. Criteria's of RFD were independence with bed mobility, standing transfers, ambulation with or without a walking aid, negotiation of 3 steps, personal care, performing the home exercise regime and were evaluated by the physiotherapist. LOS was determined by the time between the end of surgery and the time the patient was discharged from the ward. We reviewed the charts for post-operatives complication or readmission within a 3 months' time frame.
Results: Male/female ratio was 7/13. The median age was 74 (min 53; max 83) and the median BMI was 26 kg/m² (+3.8SD). General anesthesia was performed for 15 patients and spinal anesthesia in 5 patients. Comorbidities were: diabetes type II (1), hypertension (10), dyslipidemia (5), there was no active smoker. The median time for RFD was 69.8 hours (+26.8 SD) and for LOS was 125 hours (+39.7 SD). The median delta between both was 28 (+26 SD). We noticed only one postoperative complication, urinary retention treated by urinary catheterization. No blood transfusions or readmissions were noted within the 3 postoperative months.
Conclusion: Our study showed similar results regarding RFD compared to the current international literature. Nonetheless our median LOS was two days longer. Due to the absence of major complications in our series we have no explanation other than patient convenience.

P47

Proximal femoral osteotomies in adult patients with combined surgical hip dislocation: First results with the LCP Pediatric Hip Plate (TM)

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Introduction: Torsional deformities, valgus and varus deformities and focal osteonecrosis of the femoral head are indications for proximal femur osteotomies (PFO) in adults. We often combine PFO with surgical hip dislocations (SHD) to address concomitant intraarticular problems. Blade plates have been routinely used for PFO, but refixation of the trochanteric osteotomy (TO) in the setup of SHD is challenging. The LCP Pediatric Hip Plate TM allows fixation with locking screws in the femoral neck facilitating refixation of the TO. Various plates with different shaft-neck angles allow basically any correction. We report our first experiences for PFO using the Pediatric Hip Plate (TM) with concomitant surgical hip dislocation.
Methods: We retrospectively analyzed radiological and clinical outcome of 21 patients (21 hips) with PFO using the Pediatric Hip Plate (TM) and SHD with TO between 12/2008 and 01/2016. Adult patients (>16 years) with a minimum followup period of 1 year were included. Indications for PFO included combined valgus and high femoral antetorsion (7 hips), isolated high femoral antetorsion (5 hips), hip dysplasia (3 hips) and avascular necrosis of the femoral head

(6 hips). Mean age was 28 years ± 9 (18-51years). Indications for SHD included inspection of cartilage damage, offset correction and intraoperative testing of impingement.
Results: Twenty-one patients (21 hips) were included. Isolated deformity correction was performed in 12 hips (57%), combined varisation and derotation or flexion in 9 hips (43%). Mean corrective angle for varisation was 16° ± 4 (10-20) and 22° ± 7 (15-40°) for derotation. Time to union was 5 ± 3 months (2–12 months) for the PFO and 2 ± 0.5 months (2–3 months) for the TO. Mean followup time was 2 ± 1 years (1–6 years). Complications were observed in 4 hips (22%) including revision osteosynthesis due to non-union of the PFO in 2 hips (10%) and implant failure due to loosening of one screw without revision surgery in 2 hips (10%). Non-union of the TO after one year was observed in one hip (5%). No deep wound infection occurred.
Conclusion: The LCP Pediatric Hip Plate (TM) is an implant with acceptable complication rate for PFO in adult patients. It allows corrections in all planes and stable fixation of the head-neck fragment as well as the trochanteric fragment with conventional screws when a concomitant surgical hip dislocation is performed. It represents an alternative to the traditional blade plate.

P48

Clinical accuracy of a patient-specific femoral osteotomy guide in minimally-invasive posterior hip arthroplasty

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Introduction: Especially in minimally invasive hip surgery, where reliable bony landmarks are often inaccessible, patient specific guides can be a valuable tool in improving precision of the planned femoral neck osteotomies. The aim of our study was to validate the accuracy of a novel patient specific femoral osteotomy guide for THR through a minimally invasive posterior approach, the direct superior approach (DSA).
Methods: As part of our routine preoperative planning 30 patients underwent low dose CT scans of their arthritic hip. Using these, 3D printed patient specific femoral neck osteotomy guides for DSA were then produced. Intraoperatively, having cleared all soft tissue with the enlocated hip the guide was placed and pinned onto the posterolateral femoral neck. The osteotomy was then performed using an oscillating saw and the uncemented hip components were implanted as per routine. Postoperatively, the achieved level of the osteotomy at the medial calcar was compared with the planned level of resection using a 3D/2D matching analysis (Mimics X-ray module, Materialise, Belgium).
Results: A total of 30 patients undergoing uncemented TrinityTM acetabular and uncemented TriFit TSTM femoral component arthroplasty (Corin, UK) were included in our analysis. All but one of our analyzed osteotomies were found to be within 3 mm from the planned height of osteotomy. In one single patient the level of osteotomy deviated 5mm below the planned level of resection.
Conclusion: Preoperative planning and the use of patient specific osteotomy guides provides accuracy of femoral neck osteotomies in minimally invasive hip arthroplasty using direct superior approach.

P49

Influence of surgical approach on heterotopic ossification after total hip arthroplasty – is minimal invasive better? A case control study

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Introduction: Heterotopic ossification (HO) is a well-known complication after total hip arthroplasty (THA). Recently, the trend is to operate THA minimally invasive being less traumatic than standard approaches and promising a faster return to activity. The purpose of the study was to investigate if minimal invasive surgery (MIS), leads also to less HO after THA.
Methods: This retrospective study included 134 consecutive patients undergoing THA. In 42 (31.3%) patients a standard modified anterolateral (STD-Watson-Jones), in 28 (20.9%) patients a standard transgluteal Bauer approach (STD-Bauer), in 39 (29.1%) a MIS direct anterior approach (AMIS) and in 25 (18.7%) patients a MIS anterolateral (MIS-AL) approach was used. Standard preoperative anterior-posterior and lateral radiographs were assessed for occurrence of HO. HO was classified according to Brooker. In addition, short- and long-term adverse events were noted. Data was statistically analyzed using Chi-square tests, analysis of variance, multivariate data analysis and Pearson's correlation ($p < 0.05$).
Results: Overall, HO was found in 38 Caucasian patients (28.4%) after THA. The STD-Watson-Jones group showed the highest HO rate (45.2% n = 19) with a significant difference to the AMIS (23.1% n = 9) and STD-Bauer approach (14.3% n = 4). No statistical difference was found to the MIS-AL approach (24.0% n = 6). Postoperative complications did not differ significantly except for a higher incidence of Trendelenburg sign in STD-Bauer.
Conclusions: The rate and degree of HO after THA were significantly different with regards to the surgical approach. The standard modified anterolateral approach resulted in the highest HO rate, however, MIS approaches showed higher HO rates than the STD-Bauer.

P50

Good functional outcome in 34 patients suffering insufficiency fractures of the pelvic ring treated with percutaneous screw stabilisation

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Introduction: Pelvic ring fractures in the elderly occur with increasing incidence after low-energy trauma and are a domaine of conservative treatment. This can be associated with severe complications. Since 2010 we perform surgical stabilization of the posterior pelvic ring in patients with symptomatic fragility fractures of the pelvis.
Methods: Patients with CT-verified persistently symptomatic low-energy fractures of the posterior pelvic ring were stabilised surgically with CT-guided implantation of 1–2 sacro-iliac screws. All patients who received surgical stabilisation from 5/2010 to 12/2015 were invited for follow-up (FU) in 2016, minimum one year after the operation. Radiographic examination, Timed Up and Go test (TUG), pain assessment with Visual Analog Scale (VAS) and housing situation were prospectively assessed, intra-operative details and complications were recorded retrospectively.
Results: 51 patients were operated in this 5-year period. 6 patients died, 9 declined participation and 2 had left Switzerland. 34 patients completed the assessments with a mean 817 days FU. The mean age of all 51 operated patients was 79 years (SD 8). The mean duration of symptoms was 128 days (SD 104). Of 51 patients, 13 had surgery-related complications; 1 patient had a minor bleeding and 1 patient an intra-foraminal screw placement. 5 patients had to be re-operated for insufficient initial stabilisation. In 6 patients one or several posterior screws backed out but in only 2 patients screw removal was necessary. The mean TUG was 19.2 sec. (SD 10), the mean VAS at FU 1.3/10 (SD 1.8). Preoperative 39 patients lived independently, 2 lived in nursing homes and on 10 we had no information. After the operation 4 patients lost independence and were institutionalised, 35 still live independently.
Conclusion: The high number of patients living independently after surgical treatment indicates a good functional level after surgical stabilization of pelvic fragility fractures. In comparison, 30% of 132 a similar Patient cohort with a mean age of 83 treated conservatively from 2009 to 2011 at our institution lost independence. The TUG after surgery is slower than in the healthy age-matched population but better than in patients one year after hip fracture. The radiation dose acquired with the intervention equals the dose of a diagnostic pelvic CT, which seems justifiable. We had to re-operate 9 out of 51 patients (17%) due to insufficient stabilization or other complications.

P51

Early intra-prosthetic hip dislocation in dual mobility implant: an unusual complication

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Introduction: Dual mobility implants are useful tools for preventing hip dislocation in primary and revision hip prosthesis. These devices have numerous advantages, but can also bring extra complications. One of these complications is the intra-prosthetic dislocation. Literature show few publications about late dislocation due to wear retention of the cup; early dislocation however is much less common, with very few data describing this phenomenon. We describe an intra-prosthetic dislocation linked to a reduction manoeuvre and document this case exclusively with scannographic and intraoperative images.
Methods: A 78-year-old woman presented a first dislocation 6 days after revision of her total hip prosthesis with total dual mobility implants. Initial closed reduction was uneventful, but the hip felt unstable. The standard radiographies after reduction showed no anomaly, with a head centred in the acetabular implant. We therefore

performed a CT-scanner of the pelvis showing an intra-prosthetic dislocation of the dual mobility hip implant.
Results: Decision was made for revision of the hip prosthesis, finding the liner in the great gluteal muscle, detached from its initial position between the neck and shell. We opted for reorientation of the acetabular implant with another dual mobility hip implant. Postoperative clinical and radiographic controls were satisfactory, without any complication. Harris Hip Score was 82 at 2-year postoperative.
Conclusion: Dual mobility implants are good solutions to reduce the risk of hip prosthesis dislocation, but increase the potential number of complications due to an increase of interfaces. In case of dislocation of such an implant, we recommend to do closed reduction under general anaesthesia reducing the risk of intra-prosthetic dislocation. Dealing with an irreducible prosthesis dislocation with a dual mobility implant, we recommend to do a CT-scan to exclude a intra prosthetic implant dislocation.

P52

Prosthetic loosening due to metallosis caused by disintegration of the Sulmesh layer of a Fitmore cup

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Introduction: After total hip arthroplasty metallosis (adverse reaction to metal debris ARMD, aseptic lymphocytic vasculitis associated lesion ALVAL) is mainly associated to metal-on-metal bearing surfaces utilizing large heads (≥36 mm) and trunnionosis, defined as metal wear at the head-neck junction of a total hip implant. We report a case where disintegration of the osteo-integrated parts of the Sulmesh layer of a Fitmore cup created metallosis and loosening of a total hip arthroplasty.
Case report: An 81 year-old woman presented in our outpatient department with mechanical pain in the groin when walking or sitting 15 years after left total hip arthroplasty. The arthroplasty consisted of a Fitmore cup with a Metasul 28 mm inlay and a non-cemented Spotorno stem. Clinical examination showed a reduced and painful passive mobility of the left hip. Standard radiographs revealed loosening of the prosthetic cup and stem. Loosening was confirmed with a CT-scan, but additionally parts of the Sulmesh layer were detached from the acetabular cup. No signs of prosthetic joint infection were present with laboratory examination and analysis of synovial fluid aspiration. During revision arthroplasty using a transfemoral approach soft tissues and bone showed an extensive metallosis which was debrided meticulously. Both prosthetic components were loose. After removal of the cup, parts of the Sulmesh coating remained integrated in the acetabular bone and were correspondingly missing on the back of the cup. Macroscopically no other reasons for this extensive metallosis were seen by analyzing the surfaces of the prosthetic head, the cup and also the taper. The acetabulum was reconstructed by impaction grafting of the bone deficiencies, a Burch-Schneider antiprotrusio cage and a cemented UHMW-PE flat profile inlay. On the femoral side a cemented MS-30 stem was implanted. Tissue analysis showed that metallosis was caused exclusively by titanium debris.
Conclusion: This case shows that a delamination of the Sulmesh layer can be the cause of metallosis and prosthetic loosening.

P53

Hip range of motion examination is reliable and reproducible using Gyrosensor-based examination tool

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Introduction: Femoroacetabular Impingement (FAI) is a known cause for hip pain in young and active patients. Typically range of motion (ROM) is limited in patients with FAI. Limited Flexion and limited internal rotation are common findings in patients with FAI and should be improved after successful treatment for FAI. Low interobserver reproducibility is a known problem in orthopedic goniometer-based ROM examinations Therefore, we intended to validate an Gyrosensor-based examination tool to perform more reliable and reproducible ROM examinations in patients with FAI between two independent observers.
Aims: (1) What is the reliability in terms of mean difference? (2) What is the reproducibility in terms of mean difference for two different timepoints? (3) What is the correlation between two independent observers?
Methods: Preoperative prospective hip range of motion examination was performed in 51 patients (97 hips) with FAI or hip dysplasia. Mean age was 28 ± 9 (18–55) years and 37 patients had an anterior FAI, 9 patients had posterior FAI and 5 patients had hip dysplasia. All examinations were performed by two independent observers with minimum 1 year of experience in hip examination. All examinations included assessment of flexion, extension, internal rotation in 90° of flexion, external rotation in 90° of flexion, internal rotation in extension, external rotation in extension. A subset of 10 patients (20 hips) were examined at two different time points for interobserver reproducibility. For interobserver Reliability and correlation we included total of 117 hip range of motion examinations. Spearman correlation coefficient was used.
Results: (1) Reliability in terms of mean differences for two examinators were 1.4° for flexion, 1.2° for extension, ,2.8° for External rotation in 90° of flexion, 0.8° for internal rotation in 90° of Flexion , (2) Reproducibility in terms of mean difference for two examinators at two different timepoints were 0.5 +/ 0.1- for flexion, 1.5 ± 1.4 for extension, 3 ± 1 for external rotation in extension and 2 ± 0.5 for internal rotation in extension. Correlation between two different timepoints was 0.95 ($p < 0.001$) (3) Correlation coefficient between two independent observers was 0.91 ($p < 0.001$) for all ROM parameters of a total of 117 examinations.
Conclusion: We found a excellent correlation and good reliability and reproducibility for Gyrosensor based examination tool and present an alternative to Goniometer-based examinations.

P54

The FADIR test accuracy for screening cam and pincer morphology in youth ice hockey players

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Introduction: Ice hockey players are high-risk athletes for presenting cam morphology and developing femoroacetabular impingement syndrome. Regular cam and pincer morphology screening in such high-risk populations is of interest for providing athletes with timely preventive and eventually treatment measures. Aim of this study was to evaluate the accuracy of the flexion-adduction-internal rotation (FADIR) test for screening cam and pincer morphology in youth male ice hockey players without clinical hip disorders.
Methods: Seventy-four ice hockey players with a mean age of 16 years (range: 13 to 20 years) were assessed unilaterally. The presence of cam and pincer morphology as well as acetabular labral alterations was evaluated using the FADIR test and magnetic resonance imaging (MRI) (reference standard). Positive FADIR test consisted of groin pain during the maneuver, while positive MRI findings consisted of cam and/or pincer morphologies and acetabular labral alterations. Sensitivity, specificity, positive and negative likelihood ratios, and positive and negative predictive values were calculated.
Results: The sensitivity of the FADIR test was 41% (95% CI: 18 to 67%) and its specificity was 47% (95% CI: 34 to 61%). The FADIR test positive likelihood ratio was 0.78 (95% CI: 0.42 to 1.45) and its negative likelihood ratio was 1.24 (95% CI: 0.77 to 2.01). The positive predictive value of the FADIR test was 19% (95% CI: 8 to 35%) and its negative predictive value was 73% (95% CI: 56 to 86%).
Conclusion: The FADIR test is inadequate for screening cam and pincer morphology in youth ice hockey players without clinical hip disorders because of the large number of false positive test outcomes and – to a lesser degree – false negative test outcomes.

P55

Pain, activities of daily living and sport function at different time points after hip arthroscopy in patients with femoroacetabular impingement: a systematic review with meta-analysis

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Introduction: Hip arthroscopy seems to reduce hip pain and improve function of patients with femoroacetabular impingement (FAI) mostly based on low level of evidence case series. Hip arthroscopy outcomes have been mainly assessed using composite scores at a single time point after surgery, which do not enable the evaluation of changes in specific domains over time. The aim of this systematic review was to investigate hip pain, activity of daily living (ADL) function, sport

function, quality of life and satisfaction reported by patients with FAI at different time points after hip arthroscopy.
Methods: The databases EMBASE, MEDLINE, SportsDiscus, CINAHL, Cochrane Library and PEDro were searched until 20 September 2015. Studies that evaluated pain, ADL function, sport function, and quality of life by means of outcomes subscores before and after hip arthroscopy and postoperative satisfaction in patients with symptomatic FAI were included.
Results: A total of 26 studies (22 case series, 3 cohort studies, 1 randomised controlled trial) were included in the systematic review and 19 in the meta-analysis. Clinically relevant pain and ADL function improvements were first reported between 3 and 6 months, and sport function improvements between 6 months and 1 year after surgery. It is not clear when quality of life improvements were first achieved. On average, residual mild pain and ADL and sport function scores lower than their healthy counterparts were reported by patients following surgery. Postoperative patient satisfaction ranged from 68% to 100%.
Conclusion: On average, patients reported earlier pain and ADL function improvements, and slower sport function improvements after hip arthroscopy for FAI. However, average scores from patients indicate residual mild hip pain and/or hip function during ADL and sport lower than their healthy counterparts after surgery. Owing to the current low level of evidence, future randomised controlled trials and cohort studies should investigate the effectiveness of hip arthroscopy in patients with FAI.

P56

Evaluation of the ORTHOFIX CHIMAERA nailing system for trochanteric fracture treatment

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Background: The number of people sustaining a hip fracture continues to rise worldwide due to an increasingly aging population. Approximately 50% of all hip fractures are extracapsular, which can be treated with intramedullary nails.
Objectives: Evaluation of the surgical management, outcome and complications in the first 50 patients treated with the ORTHOFIX CHIMAERA nailing system for trochanteric fractures in our institution.
Material and Method: Since October 2016, 50 consecutive patients with a trochanteric fracture were treated with the ORTHOFIX CHIMAERA nailing system. Skin-to-skin time, fluoroscopy time, intraoperative complications were recorded for each patient. Follow-up postoperative assessment was undertaken at 6 and 12 weeks. Radiological assessments were performed before and after the surgery, and during the follow-up (fracture reduction, cervical screw position, consolidation or collapse signs). The results were compared with those of a previous serie of 50 patients treated with Gamma 3 nails.
Results: The median operation time from cut to stich was 54 min. The median fluoroscopy time was 62 sec. No intraoperative implant-related complication was recorded. The cephalic screw position was centre-centre or inferior-center in 96% of patients. Tip-apex distance was less than 25 mm in 98%. No complication (cut-out or cut through of the cervical screw, hardware failure, painful fasciae latae) occurred during assessment period.
Conclusions: Our preliminary results of the first 50 patients treated with the ORTHOFIX CHIMAERA nailing system for trochanteric fracture seem to be comparable to those of a previous serie of 50 patients treated with Gamma 3 nails.

P57

What are the clinical outcomes of the revisions after large head metal-on-metal total hip arthroplasty? Thirty-eight cases with at least 2 years of follow-up

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Introduction: A particularly high rate of failure with necessity for revision in up to 20% of cases at 14 years has been reported with large-diameter metal-on-metal total hip arthroplasty (>36 mm). Clinical results after these operations are still little known. The hypothesis of this study was that results after a revision for a large head metal-on-metal total hip arthroplasty (MoM THA) were comparable to those after primary THA. Thus the aims of this study were to evaluate (1) the complication rate (infection, dislocation, implants loosening) after revision and (2) the clinical results of these revisions in comparison to a primary THA.
Methods: 38 cases of large head metal-on-metal THA were revised in our service during 2010 and 2014. Mean age at surgery was 66 ± 11 (45–86) years, with a BMI of 27 ± 4 (22–35). The revision group has been paired regarding age, sex, BMI and Charnley score with a group of patient operated for a primary THA. Indication for surgery was made upon a high chromium and cobalt blood level, presence of pain and imaging. Cases with infectious or fracture motive for surgery were excluded. At revision, 100% of the femoral stems were retained and in all cases we substituted the bearing surfaces. In 29 cases a dual-mobility cup has been used with ceramic-on-polyethylene bearing surfaces and in 9 cases a ceramic-on-ceramic cup was chosen. Mean interval between initial hip replacement and revision was 5 ± 2 (3–7) years. Complications were reported. Clinical results were evaluated through the Hip Harris score and the HOOS. Mean follow-up was 3 ± 1 (2–6) years.
Results: In the revision group 1 patient developed an infection which has required another operation. No dislocation or implant loosening has occurred in this group. In the paired primary THA group no complication has been reported. Clinical scores (Hip Harris / HOOS) were comparable in the two groups ($p > 0.05$) at the latest control. Nonetheless, 5 patients showed persistent pain (>3 months); all these patients had a clear and extended pseudotumor at time of revision.
Conclusion: It is of foremost importance to establish a careful clinical follow-up for patients with a large head MoM THA, in accordance with current recommendations and this to precociously detect complication justifying a revision. Based on our experience we think that it is presumably through an early revision concept that we obtained similar clinical results when comparing revision after large-diameter MoM THA and primary THA.

P58

The influence of neuropathic pain after total joint arthroplasty: a 1-year longitudinal study

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Hôpitaux Universitaires de Genève

Introduction: 10–20% of patients undergoing Total Hip (THA) and Total Knee arthroplasties (TKA) complain of chronic postoperative pain, which is strongly associated with dissatisfaction. Neuropathic Pain (NP) is defined as pain originating from a lesion or disease within the peripheral or central nervous system. Recent studies reported evidence that up to 25% of patients complain of NP preoperatively and up to 35% postoperatively. Our objective was to longitudinally assess NP pre- to one year postoperative, and its influence on overall pain and satisfaction.
Methods: Prospective cohort study including all patients undergoing either THA or TKA in our tertiary care institution between January 2014 and July 2015. NP was evaluated pre and 1yr postoperative with use of the DN4 score (= neuropathic pain diagnostic questionnaire). We also evaluated its influence on patient overall pain (VAS), function (WOMAC), and satisfaction.
Results: Of 740 TJAs eligible,535 returned the questionnaire (response rate 72.3%). Their mean age was 69.3 (±10.9) years, mean BMI 28.1 (±5.2) kg/m², 59.3% were women and 58.3% underwent THA. Among 473 patients without preoperative NP, 22 (4.7%) reported NP one-year postoperatively. Of 62 patients with preoperative NP, 12 (19.4%) had persistent NP one year after surgery. Consequently, there is a risk ratio of 4.16 (95%CI 2.2–8.0, $p < 0.001$) of having postoperative NP for someone with preoperative NP. Most patients with one-year postoperative NP (22/34 = 64.7%) did not have preoperative NP, and 50 out of 62 (80.6%) patients with preoperative NP do not report postoperative NP. Therefore, preoperative NP does not predict satisfaction one year after surgery; this is verified as 411 (87.5%) patients without preoperative NP are satisfied or very satisfied one year after surgery, as compared to 52 (85.2%) patients with preoperative NP. When compared to patients without NP, the patients with postoperative NP had a significantly higher mean level of pain on VAS (4.1 95%IC 3.5–4.8 vs. 1.7 95%IC 1.5–1.9, $p < 0.001$), and were less satisfied (63.3% vs 87.8%, $p < 0.001$ satisfied to very satisfied patients).
Conclusions: Postoperative NP is more frequent in patients with preoperative NP. However, a majority of patients with postoperative NP did not have preoperative NP. Hence, preoperative NP is not a good outcome predictor. Finally, postoperative NP is strongly associated with poorer clinical outcome and satisfaction.

P59

Arthroscopy for painful unicompartmental knee arthroplasty (UKA) – a promising alternative to open revision with exchange of components?

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Introduction: Only few studies discuss implant-retaining treatment options for painful total knee arthroplasties. Hardly any information exists for UKA. The purpose of this study was to determine structural pathologies and to evaluate if less invasive surgery (arthroscopy/ mini-arthrotomy) provides successful treatment in painful UKA?
Methods: We retrospectively reviewed all implant-preserving operations (24 arthroscopies, 7 mini-arthrotomies, 4 combined) performed for painful UKA from may 2013 – march 2016. 33 patients (16 women, 17 men) with 35 UKA (26 medial, 5 lateral, 2 bicondylar – 15 right, 20 left knees) were included. Average patient age was 61 [45–84] years. Onset of symptoms averaged at 5.4 [0–63] months after index procedure and mean time to revision was 21.4 [4–72] months after UKA implantation. Mean follow-up after revision was 6 [1.5–29] months. Preoperative complaints were evaluated clinically and by standard X-rays. Additional SPECT-CTs were performed in 23 cases. The pain was refractory to conservative treatment.
Results: Operative diagnoses included pseudomeniscus (30), osteophytes (21) – often causing impingement between femoral component and tibial eminence –, hypertrophic synovitis (9), meniscal tears (8), loose cement bodies (3), popliteus tendon impingement (1) and 2 lateral vertical patellectomies were required for patellofemoral impingement. In 69.7% (23/33 patients) complete (18.2%) or partial (51.5%) pain relief was achieved. 30.3% (10/33 patients) complained about persistent pain (21.2%) or pain worsening (9.1%). The latter was caused by infection in 1 patient (1/33, 3%). This complication was treated successfully by 2 subsequent open revisions. Another 2 subsequent revisions were needed for persistent pain associated with aseptic loosening of both components and recurrence of osteophytes/ pseudomeniscus. If Spect-CT analysis provided suspicion for impingement by notch-osteophytes (16/23), diagnosis was confirmed intraoperatively in 81%. In contrast 5 false-positive tibial loosenings and 3 false-negative stable implants (2 tibial, 1 femoral) were diagnosed.
Conclusion: Arthroscopy (± mini-arthrotomy) provides reliable expectations to evaluate and treat painful UKA. Soft tissue problems can be resolved and osteophytes removed. Thus in 69,7% successful treatment was achieved with retention of the implant. SPECT-CT was not effective in analyzing implant stability but was helpful to detect impingement by osteophytes.

P60

Allergy assessement prior to total knee replacement – is it of any clinical relevance? A cross sectional study among swiss orthopedic surgeons

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Introduction: Materials used in artificial joint replacement are usually well tolerated. However, hypersensitivity to metals in particular to nickel, chromium or cobalt have been reported to cause clinical problems. One of the major difficulties in understanding the clinical implications of hypersensitivity to orthopedic implant materials is the lack of universally accepted testing methods. This study was to assess the clinical relevance of hypersensitivity to implant materials in orthopedics and the acceptance of a preoperative patch test among Swiss orthopedic surgeons in order to detect a potential allergy in patients prior to undergo knee joint replacement.
Material and Methods: After permission was obtained from "Swiss Orthopaedics" (Swiss Society of Orthopedic Surgeons) a secured web-based questionnaire (SurveyMonkeyTM) with an accompanying text explaining the details was sent by email to all orthopedic surgeons being members of "Swiss Orthopaedics", excluding hand and spine surgeons.
Results: From 642 potential participants of the web-based survey, a total of 160 filled out the questionnaire (response rate 24.9%). The majority of respondents agreed that an allergy to nickel, chromium or cobalt in patients carrying a Co/Cr/Mo prosthesis may cause a relevant clinical problem (61% nickel, 69% other metals). 113 orthopedic surgeons (70.6%) would make an allergy test before total knee replacement if there was a positive history for prosthesis-relevant allergies. Only two respondents (1.2%) would carry out an allergy test on a routine base.
Conclusion: This survey indicates that there is no general uniform opinion about the use of an allergy patch test for orthopedic implant materials prior of undergoing total knee replacement. Currently, patch testing is the most commonly used method for evaluating metal hypersensitivity but there is no standardized procedure. Preoperative history-taking alone appears to be insufficient for identifying patients with metal hypersensitivity. Metal hypersensitivity reactions do occur but at an unknown incidence rate and prevalence. Therefore it is emphasized that general guidelines would be required.

P61

One-step autologous particulate cartilage for treatment of knee joint chondral and osteochondral lesions – preliminary prospective one-year data among 27 patients

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Introduction: Chondral and osteochondral lesions at the knee present a frequent problem and adequate treatment remains a challenge. For large diameter cartilage lesions autologous chondrocyte implantation (ACI) is state of the art. Although showing good clinical and radiological results, ACI involves two operations and is rather complex and expensive. Furthermore, it is not available in every country. Autologous minced cartilage repair technique bypasses the need for in-vitro culturing of cartilage and avoids a necessary second operation. The aim of this study was to evaluate prospectively the short-term clinical and radiological results following treatment of chondral and osteochondral lesions by an autologous minced cartilage procedure at the knee joint.
Methods: From August 2015 to January 2016 a total of 27 consecutive patients with chondral /osteochondral lesions at the knee joint have been treated by a one-step autologous particulate cartilage procedure. All patients underwent pre- and postoperative (6 and 12 months) MRI for collection of AMADEUS und MOCART MRI scoring. Clinical analysis was by a numeric analogue scale (NAS) for pain (10 worst pain) and knee function (10 worst function) at 12 months postoperatively.
Results: There were 12 female and 15 male subjects with a mean age of 28.7 years (range 16–51 years) at time of surgery. The duration of symptoms was 2.4 years on average. Average follow-up was 14.3 months. The average cartilage defect size encountered intraoperatively was 3.1 ± 1.6 cm^2. The most common location was retropatellar (63%) followed by the lateral femoral condyle (18.5%). Osteochondral lesions were seen in 55.5%. There was a significant mean decrease in pain (NAS) from preoperatively 7.2 ± 1.9 to postoperatively 2.3 ± 2.0. Knee function (NAS) also showed significant improvement from preoperatively 7.2 ± 2.0 to postoperatively 3.0 ± 2.2. The AMADEUS score was on average 42 before the operation and the MOCART score was 41 after the operation at the 6 months follow-up visit. A total of 26 patients would undergo the same procedure again.
Conclusion: Particulate autologous cartilage may turn out as an adequate alternative to other cell-based cartilage reconstruction techniques showing good regenerate tissue quality and improvement of the clinical outcome scores in the short-term among this small cohort of patients. Longer follow-up and larger cohorts are required to clearly underline this procedure.

P62

Does the Schoettle point in MPFL reconstruction clinically matter? A clinical and radiographic study

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Introduction: The reconstruction of the medial patellofemoral ligament (MPFL) has become an important treatment option for recurrent patellar instability. Positioning of the femoral tunnel is a crucial step for restoring patellofemoral joint kinematics. The main objective of the current study was to correlate the femoral tunnel positioning with clinical outcome.
Methods: 63 patients (23 ± 7.7 years at the time of surgery, 79.4% female), who underwent MPFL-reconstruction for recurrent patellar instability, were included in this retrospective study. Mean follow-up was 5.6 ± 3.2 years. The distance between the centre of the drill hole and the radiographic landmark for anatomic MPFL reconstruction ("Schoettle point") was measured on true lateral conventional radiographs only and regarded as mal-positioned with a greater distance as 10 mm. The distance was then correlated to subjective outcome measurements (Kujala score, relative knee score) and postoperative complications such as loss of range of motion, revision surgery, and recurrent instability. Furthermore, patellar height (Caton-Deschamps-Index), trochlear dysplasia, congruence angle and patellar dysplasia according to Wiberg were recorded.

Results: The centre of the drill holes had an average distance of 13.3 mm to the Schoettle point, and 32 out of 63 knees were found to be malpositioned. There was no correlation to be found with Kujala score, patients' satisfaction or any patellofemoral measurement. However, four out of the five knees requiring mobilisation under femoral nerve catheter due to loss of range of motion showed a malpositioned femoral tunnel.
Conclusion: A malpositioned femoral tunnel in MPFL reconstruction will not necessarily lead to an adverse postoperative outcome however is associated with postoperative complications such as loss of range of motion. It seems warranted to analyse the influence on subjective outcome in function of other factors such surgical indication, graft tensioning, and patellar height.

P63

Early advantage of patellofemoral arthroplasty is not age dependent

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Introduction: Most orthopedic surgeons are restrained using isolated patellofemoral arthroplasty in patients with isolated patellofemoral joint degeneration and prefer total knee arthroplasty. While in young patients the advantage to postpone total knee arthroplasty is obvious, the advantages for middle aged and older patients are less known. The goal of this study was therefore to assess the clinical and radiographic outcomes of our series of patellofemoral arthroplasty and correlate it with patients' age.
Methods: Retrospective case series of prospective data of 22 consecutive patients (mean age 48.3 years, 31–82 years) which were treated between 2012 and 2015 with the HemiCAP® Wave Patellofemoral Prosthesis (Arthrosurface, Franklin, MA, USA) for isolated patellofemoral arthrosis at a single center and single surgeon. Mean follow-up was 22.8 months (range, 18–30). Variables included Lysholm, WOMAC, VAS Scores, Kellgren–Lawrence grading, need for blood transfusion or inpatient rehabilitation.
Results: 16 patients with 18 implanted prostheses were available for the follow-up, two patients had bilateral resurfacing. One patient dropped out because of revision with TKA needed at 11 months postoperatively. Of 18 prostheses, 88,9% reported a satisfactory or very satisfactory overall outcome. Significant improvements in functional scores were found in Lysholm Score (preoperative mean 50.6 ± 22.9 to 2-years postoperative 76.4 ± 16.7, $p = 0.013$), WOMAC (49.2 ± 19.2 to 76.3 ± 19.1, $p < 0.001$), VAS score (5.9 ± 2.4 to 2.3 ± 2, $p < 0.001$). No significant progression of tibiofemoral OA was observed (Kellgren-Lawrence scores for medial compartment, preoperative 1.3 ± 0.5 to 1.5 ± 0.8 after 2 years, $p = 0.44$, and lateral 0.85 ± 0.8 to 1.1 ± 0.8, $p = 0.46$). No patient needed blood transfusion or inpatient rehabilitation. No correlation of any variable with age has been found.
Conclusion: In our series, patellofemoral arthroplasty was found to be an effective procedure to treat patients with isolated patellofemoral degeneration. Even the older patients had early benefit from this procedure because of its lower morbidity and blood loss compared to the literature outcome for total knee arthroplasty.

P64

Lengthening of a posttraumatic leg length discrepancy of 23 cm by distraction osteogenesis of the femur – a case report

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Introduction: We present the case of a posttraumatic leg length discrepancy of 23 cm with severe deformity of the femur, knee and the tibia, which was treated by knee arthrodesis followed by distraction osteogenesis.
Objectives: Intramedullary motorized lengthening devices allow reducing problems associated with external fixators in distraction osteogenesis, such as pintract infections, reduced range of motion of adjacent joints, lack of tolerance by the patient and fracture risk after removal of the fixator.
Methods: The 27 year old male patient suffered from a severe, posttraumatic leg length discrepancy and a deformity of the knee after a car accident at the age of 6 years. The knee had a flexion contracture of 30° with posterior subluxation of the proximal tibia and a valgus of 10°. Compared to the contralateral side, the femur was shortened by 18 cm and the tibia by 5 cm.
Results: First a knee arthrodesis was performed using an antegrade intramedullary nail (Stryker T2). The procedure was complicated by a compartment syndrome of the lower leg, which required several soft tissue procedures and resulted in residual neurological deficits of the foot. After 10 months and radiological fusion of the knee, the magnetic driven intramedullary PRECICE nail was implanted and the femoral corticotomy done. Uncomplicated distraction osteogenesis followed with 0.25–0.5 mm lengthening/day. 4 months later, when the maximum length allowed by the device was reached, the nail was exchanged to a new PRECICE nail, with which a total lengthening of 16 cm was achieved. Due to the fixed equinus of the foot, functionally the patient has achieved full leg length equalization 8 months after the last procedure and 24 months after the index procedure. Ambulation without canes or residual pain was possible 2 months later.
Conclusions: In this case of a complex posttraumatic deformity with severe soft tissue damage of the lower limb and incapacitating leg length discrepancy of 20 cm a good resultat and lengthening of 16 cm was achieved using the fully inserted PRECICE nail avoiding the soft tissue problems, which precluded in this patient an external device.

P65

Fresh osteoarticular allograft reconstruction in posttraumatic articular defect of the lateral tibial plateau

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Introduction: Posttraumatic osteoarticular defects around the knee remain a challenging issue in orthopaedic surgery. Joint preservation should be considered whenever possible, especially in young patients. Osteoarticular Allograft Transplantation (OAT) is described mainly after tumor resection with promising outcome, but only a few publications describe OAT in posttraumatic reconstruction.
Case Report: A 34-year-old man sustained a lateral tibial plateau fracture of the right knee during skiing (fig. 1). Open reduction and internal fixation was performed. Retrospectively the postoperative x-ray demonstrated insufficient reduction. Subsequently the patient reported persisting pain in the lateral aspect of the knee during weight bearing, especially when applying rotational motion. Malunion with bony defect and joint incongruence was confirmed by CT-scan (fig. 2). The defect measured 28 × 22 × 8 mm and was located in the central aspect of the lateral tibial plateau. Due to the patients young age, a still intact femoral articular surface, a stable knee and a neutral leg alignment we indicated a joint reconstruction with a fresh tibial OAT including the lateral meniscus. At 6mt follow-up the patient was pain free with full flexion and a 5° lack of extension (compared to the the contralateral side). X-ray and MRI showed a good osteointegration of the allograft without any signs of collaps.
Conclusion: At 6mt follow-up the patient was pain free with full flexion and a 5° lack of extension (compared to the the contralateral side). X-ray and MRI showed a good osteointegration of the allograft without any signs of collaps.

P66

A single-shot of viscosupplement increases gait speed in patients with OA knee

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Background: The new generation of viscosupplements contain polyols that are expected to be more effective in reducing joint inflammation and undesired side effects in patients with knee-osteoarthritis (OA). Single bolus injections with new generation biological hyaluronic acids (HA) have never been tested in conjunction with gait analysis.
Objectives: This study aimed to investigate which gait parameters are more sensitive to change following new generation HA injection.
Study Design & Methods: This 3-arm randomised double-blind pilot study was conducted in a tertiary hospital setting. Outcome measures used were gait analysis through a portable data logger Physilog® with five inertial sensors (BioAGM, La-Tour-de-Peilz, Switzerland), EuroQol five-dimensions questionnaire (EQ-5D), a visual analogue scale (VAS) pain and stiffness scores, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the Knee Society score (KSS). Twenty-two patients with Ahlbäck stage 1–3 knee-OA were randomly allocated into three groups: one group received a sorbitol-containing viscosupplement (n = 5), one group a mannitol-containing viscosupplement (n = 9) and a placebo group (n = 8). Patients were assessed by blinded observers prior to the injection and at 4 weeks (4W).

Results: The differences between 4W and baseline were statistically significant for the mannitol containing viscosupplement with a median increase of 0.076m/s on gait speed (p = 0.039), 0.055 m on stride length (P = 0.027) and 15 points on the KSS (P = 0.047).
Conclusions: In the literature seven trials used gait analysis following HA knee injection. There is a wide heterogeneity throughout the design of the studies, the outcome measures chosen, methods of data collection and the substances delivered. Some trials failed to show the effectiveness of viscosupplementation using gait analysis. However, this is likely due to the parameters chosen and/or patient selection. The mean increase in gait speed in the present study is thought to be clinically important. This represents approximately 13% more than the mean difference between healthy and OA knee subjects. However, it is unknown whether increasing walking speed will result in accelerated degeneration or delayed time for a total knee arthroplasty.

P67

The type of approach (medial versus lateral) influences TKA component rotation in total knee arthroplasty – a clinical study using 3D-CT

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Introduction: The purpose of this study was to investigate if the type of approach (medial parapatellar approach (MPA) versus lateral parapatellar subvastus approach with tibial tubercle osteotomy (LPA)) influences the rotation of femoral and/or tibial component and leg axis in total knee arthroplasty (TKA).
Methods: This study included 200 consecutive patients in whom TKA was performed using either a parapatellar medial (n = 162, MPA) or parapatellar lateral subvastus approach with tibial tubercle osteotomy (n = 38, LPA). All patients underwent clinical follow-up, standardised radiographs and computed radiography (CT). TKA components' position and the whole leg axis were assessed on 3D reconstructed CT scans (sagittal, coronal and rotational). Mean values of TKA component position and the whole leg alignment of both groups were compared using a T-test. The tibial component was graded as internally rotated (<3° of external rotation (ER)), neutral rotation (equal or between 3° and 6° of ER) and and externally rotated (>6° ER). The femoral component was graded as internally rotated (<3° of internal rotation (IR)), neutral rotation (equal or between -3° IR and 3° of ER) and externally rotated (>3° ER).
Results: There was no significant difference in terms of whole leg axis after TKA between both groups (MPA: 0.2° valgus ± 3.4; LPA: 0.0° valgus ± 3.5). Means of tibial component position were 2.7° ER ± 6.1 (MPA) and 7.6° ER ± 5.4 (LPA). Patients of group LPA presented a significantly less internally rotated (LPA: 18.4%; MPA: 48.8%) and more externally rotated (LPA: 52.6%; MPA: 22.8%) tibial component (p <0.001). No significant differences were seen for the femoral component position, tibial valgus/varus and tibial slope.
Conclusion: The type of approach significantly influences the tibial TKA component rotation. It appears that a MPA tends to internally rotate the tibial TKA component and a LPA tends to externally rotate the tibial TKA.

P68

Three-dimensional accuracy of high tibial osteotomy using two generations of CT-based patient-specific guides

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Introduction: High tibial osteotomy (HTO) is a useful treatment option in early osteoarthritis due to the possibility of joint preservation. However, planning and realization of planning are challenging. Patient-specific instrumentation (PSI) has previously been established in joint replacement and is now more and more introduced in osteotomies. The goal of this study is to assess the 3D-accuracy of HTO using an initial and a revised generation of CT based PSI.
Methods: All patients who underwent PSI-HTO between 03/14-08/16 were retrospectively included. Data were collected on mechanical axis, posterior tibial slope (pTS), joint line convergence angle, lateral proximal femoral angle, lateral distal femoral angle, medial proximal tibial angle, lateral distal tibial angle, and intersection point between mechanical axis and tibia plateau. Based on CT-scans, 3D differences between preoperative planning and postoperative implementation were calculated by two raters for the following parameters: frontal tibial axis, tibial rotation, tibial slope, and rotation angle. The differences between two generations of PSI were evaluated.
Results: A total of 35 patients (45.1 ± 8.5 years) were included. Beside age and deformity, there was no significant difference between the two generations. All corresponding parameter changed significantly. The mean varus preoperatively (7.3° ± 3.8°) was changed by 9.2° ± 3 .7° (p <0.001), the pTS changed by 1.4° ± 2.9° (p = 0.009). Average 3D differences were calculated as 1.7° ± 2.5° for 3D axis, 0.3° ± 2.6° for 3D tibial rotation, 0.3° ± 2.2° for 3D tibial slope, and 4.4° ± 2.5° for 3D rotation angle. The ICC showed "almost perfect" agreement for 3D rotation angle (0.832), "substantial" agreement for 3D axis (0.626), and "moderate" agreement for 3D tibial rotation (0.573) and 3D tibial slope (0.450).
Conclusions: The utilization of patient-specific guides results in a significant and reproducible correction of mechanical axis in the setting of HTO. Only a minimal divergence in tibial slope occured while divergence of tibial axis excels average anatomical side differences. The correction of angles with the novel generation of PSI showed similar results and accuracy compared to first-generation guides but less outliers.

P69

Primary ACL reconstruction using quadriceps tendon vs hamstring autograft – a comparative study with a mean follow-up of 3.6 years

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Introduction: The quadriceps tendon (QT) autograft is known as an effective graft for primary ACL reconstruction with similar functional outcome as the bone-patellar tendon-bone (BPTB) and a lesser incidence of reported complications. No comparative study of QT vs. hamstring (HT) autograft has been published using identical surgical technique and including more than 50 knees in literature.
Methods: Ninety-five patients underwent isolated ACL reconstruction between January 1 and December 31, 2012, wherefrom 50 with QT (with a patellar bone block, BQT) and 45 with a pediculated 4 stranded HT autograft (using gracilis and semitendinosus) were included in this study. Surgical technique with outside-in tunnel drilling and graft fixation with interference screws, and postoperative rehabilitation protocol, were identical. Postoperative results were evaluated by using functional outcome scores (Lysholm, KOOS, Tegner, subjective IKDC), joint stability (KT-1000, Lachman, pivot shift), anterior knee pain (Shelbourne–Trumper score), isokinetic strength (at 90°/s using the Con-Trex Multi Joint System®), and surgical revision. Descriptive statistics are presented for these variables using Student's t-test.
Results: Eighty-six patients (45 BQT, 41 HT) agreed to participate in this prospective follow-study (3.6 ± 0.4 years, minimal follow-up 3years). The functional outcome scores were all significantly better in the BQT group than in the HT group at final follow-up (Lysholm [89 ± 6.9 vs. 81 ± 5.3], KOOS Symptoms [90 ± 11.2 vs. 81 ± 10.3] and KOOS Sport [82 ± 11.3 vs. 67 ± 12.4]). In terms of stability, the mean side-to-side difference was 1.1 ± 0.9 mm for the BQT group and 3.1 ± 1.3 mm for the HT group based on KT-1000 measurements (P <0.005). The negative Lachman (90% vs. 46 %, P <0.005) and Pivot shift (90% vs. 64 %, P = 0.052) component was higher in the BQT group than the HT group. The Shelbourne-Trumper score for anterior knee pain was the same in both groups. There was no difference between groups in terms of isokinetic strength. There were four re-operations in the QT group (including one ACL revision) and three in the HT group (including two ACL revisions) (P >0.05).
Conclusion: The use of BQT autograft in primary ACL reconstruction leads to at least equal or even better functional results compared to the use of a quadrupled HT autograft, without increased anterior knee pain or other donor-side morbidity.

P70

Isolated knee arthritis as early and only symptom of Whipple's disease: a case report

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The clinical diagnosis of the Whipple's disease, a rare bacterial infection, due to the wide variability of manifestations, is very difficult. It may involve any organ system in the body. The gastrointestinal tract is the most frequently involved organ. Other manifestations include low-grade fever, lymphadenopathy, skin hyperpigmentation, endocarditis, pleuritis, seronegative arthritis, uveitis, spondylodiscitis, and neurological manifestations, and these signs may occur in the absence of gastrointestinal manifestations. Recently, in 2001, the Whipple bacteria have been characterized at the molecular level.

Phylogenetic analysis of these sequences revealed a new bacterial species related to the actinomycete branch which was named "Tropheryma whippelli." However, "T. whippelii" DNA has also been found in persons without clinical and histological evidence of Whipple's disease. We report a case of focal Whipple's disease involving the knee of a 64 years old female patient who presented recurrent monoarthritis whose origin was not clear. Initially the cause of the gradually invalidating symptoms was related to a meniscal lesion and a diffuse minor grade chondropathy. The discrepancy between the suspected aetiology and the clinical setting (pain and functional impairment) suggested that more exams were needed. Biopsies performed at first arthroscopy revealed the infection of Tropheryma Whipplei. This, following recommendation of rheumatologist and infectious disease specialist, led to biopsies of the gastro intestinal tract and analysis of the cerebrospinal fluid that showed no involvement a part from the knee. No evidence of a systemic infection could be found after all the investigations. The literature review confirms that an isolated monoarthritis without involvement of the gastrointestinal tract caused by this bacterium is rare but nowadays is often described as an early manifestation of the disease. Moreover, the uncertainty about epidemiology of this rare disease suggests that more and specific data are required.

P71

Surgical treatment of mild to severe hallux valgus deformities with a percutaneus subcapital osteotomy combined with a lateral soft tissu procedure

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Background: In the surgical treatment of hallux valgus (HV), distal metatarsal (MT) osteotomies have been used in mild or moderate cases and proximal MT osteotomy has been considered the treatment of choice for severe deformities. A distal osteotomy could achieve a greater degree of correction by the addition of a distal soft-tissue procedure and be used to treat also severe deformity.
Objectives: Limited evidence about the use of the percutaneous subcapital osteotomy (SCOT) in combination of a soft tissue procedure, which could unify the advantages of both techniques, is available. We evaluated this procedure routinely used in our clinic.
Study Design & Methods: A total of 30 consecutive patients suffering from painful HV and treated with SCOT combined with lateral soft tissue release in our hospital from September 2012 to April 2015 were included in this retrospective review. Outcomes assessed included radiological parameters: HV angle (HVA) and intermetatarsal angle (IMA), clinical evaluation using the American Orthopaedic Foot and Ankle Society score (AOFAS) and complication rate.
Results: In 12 of the 30 patients included, the pathology was bilateral, comprising a total of 42 surgical cases analyzed. The overall correction of the angles was statistically significant ($p < 0.001$), changing from a HVA of 28.2o and IMA of 13.5 preoperatively to HVA of 8.0o and IMA of 6.0 postoperatively. The cases were divided into mild-moderate (34/42) and severe (8/42). Both groups showed a statistically significant correction in the angles, 3 months after surgery ($p < 0.001$). The AOFAS score showed a median of 49 points ($n = 24$) preoperatively and of 95 points ($n = 40$) at the end of follow up. The complication rate at end of follow-up was 19% (8/42).
Conclusions: After a minimum follow-up of one year, our technique for HV correction results in great a clinically relevant improvement of the radiological parameters and AOFAS score in mild to severe deformities. Combination with lateral release could be important a meaningful surgical alternative for the treatment of severe cases to help decrease the risk of recurrence.

P72

The circular arc internal fixation for tibio-talo-calcaneal arthrodesis

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Introduction: Stabilizing a tibio-talo-calcaneal arthrodesis in anatomical alignment allowing for weight bearing is a technical challenge. Normal anatomy demonstrates alignment of the heel, the posterior subtalar facet, the talus, the ankle joint and the distal tibia on a circular arc. This arc lies on a vertical plane which is slightly angulated inwards in relation to the sagittal plane. Today's hindfoot nails do not respect this alignment. Complications include malalignment, primary instability, plantar neuropraxia. Purpose of the study is to optimize the technique to stabilize the hindfoot in anatomical alignment.
Methods: An instrumentation was designed to create a circular arc bore hole crossing the heel, the posterior subtalar facet, the tibio-talar joint and the distal tibia metaphysis. At the operation, the desired definitive position of the hindfoot is fixed temporarily with Kirschner wires. A guiding frame is fixed to three critical spots of the hindfoot to drill the central hole. Using an image amplifier the hole is bored using a motor driven end cutting flexible reamer which is seated within a rigid curved hull. The nail has the same shape than the hull and is impacted up to the distal tibia. The nail allows for eventual secondary impaction without losing full contact with the surrounding bone. 18 patients have been treated so far using this technique.
Results: The pathology of the operated patients include post-traumatic, congenital and metabolic (diabetes) conditions. The mean follow-up is 12 months. We did observe 3 ruptures of the tibial locking screw which allowed for more spontaneous impaction. All cases went to consolidation without malunion or other complications. One diabetic patient developed a stable pseudarthrosis at the midfoot joints. The patients were treated for 2 weeks post-op with a closed circular cast allowing heel contact to the floor. After 2 weeks our patients did practise partial to full weight bearing using a cam walker for other 6 weeks.
Conclusion: The tibio-talo-calcaneal arthrodesis can be successfully treated using a central circular arc shaped nail allowing for full form fit between implant and bone. The anatomical bony alignment of the hindfoot is corrected or preserved. Due to the safe and limited approaches, the technique prevents complications such as neurological complications and non-unions. We expect a shorter period of time between surgical fixation and full weight bearing.

P73

Long-term results after internal partial forefoot amputation (resection)

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Introduction: Internal partial forefoot amputation of a phalanx or metatarsal head is a treatment option, which can prevent minor or major amputation in the treatment of osteomyelitis refractory to antibiotic therapy and in the treatment of refractory and recurrent chronic ulcers of the forefoot. Disadvantages of this treatment option are the problem of ulcer recurrence and transfer lesions and of a high rate of re-amputation. The aim of our study was to control if internal partial forefoot amputation is a valuable treatment option with regard of the healing rate of osteomyelitis and/or chronic ulceration, risk of ulcer recurrence at the same area or re-ulceration at a different area and revision rate.
Methods: We included all patients who underwent internal partial forefoot amputation of a phalanx or metatarsal head at our institution because of chronic ulceration of the forefoot and/or osteomyelitis from 2004 to 2014. Information about patient characteristics, healing of ulceration, new ulcer occurrence, and revision surgery were collected. Kaplan-Meier survival curves were plotted for new ulcer occurrence and revision surgery.
Results: A total of 102 patients (mean age 67.6 years) were included with 108 operated feet. In 60 (55.6%) cases the patient had diabetes disease. In 56 cases a metatarsal head resection was performed, in 5 cases an isolated resection of sesamoids and in 57 cases an internal partial amputation of a phalanx. The mean follow-up was 40 months. 93.3% of ulcers healed after a mean period of 3.3 months, In 56 feet (52.3%) a new ulcer appeared: It was localized at the same area as initial ulcer in 11 cases (= ulcer recurrence), in 45 cases it was localized elsewhere (= re-ulceration). Ulcer recurrence occurred after a mean period of 10 months, re-ulceration after a mean period of 16.4 months. Revision surgery was necessary in 39 feet (36.1%). The mean time interval to first revision surgery was 16.8 months. Only one major amputation and 6 complete transmetatarsal forefoot amputations were necessary during the follow-up.
Conclusion: Internal partial forefoot amputations are a successful treatment of osteomyelitis refractory to antibiotic treatment and of chronic ulcers of the forefoot. However, new ulceration is a frequent event following this type of surgery. Our results are consistent with the reported re-ulceration rate after conservative treatment of diabetic foot ulcers. The number of major amputations can be reduced with this procedure.

P74

A trans-Achilles posterior approach to access a plurifragmentary fracture of the posterior talar body

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Introduction: Posterior talar body fractures are rare. The crucial point, aiming an anatomical reconstruction of the articular surface, is to access this region locked into the mortise. Due to its location, this might be very challenging. The literature advocates a posterior approach associated with an osteotomy of the medial malleolus in the majority of cases. This approach, however, does not allow a good access to the posterolateral part of the talus, which can best be addressed via a posterolateral approach in combination with an osteotomy of the distal fibula. Both approaches present, furthermore, the disadvantages associated with malleolar osteotomies.
Method: In order to avoid the need for a double malleolar osteotomy we used a posterior approach through an inverted Z-tenotomy of the Achilles tendon in the frontal plane (longitudinal plane of the Z). After having opened the deep fascia, we sectioned the pulley of the flexor hallucis longus tendon which could be then retracted medially, offering both a protection of the neurovascular bundle and a complete view on the posterior portion of the talar body. We were then able to identify, reduce anatomically and fix from posterior to anterior the 4 distinct fragments of the posterior talar body to its anterior counterpart. After closure of the articular capsule we sutured the pulley of the flexor hallucis longus tendon, the deep fascia, and then realized a Krakow suture of the Achilles tendon. We then closed the skin with simple sutures.
Result: The posterior approach combined with an inverted Z-tenotomy of the Achilles tendon in the frontal plane helped us gain access to the entire posterior part of the talar body and reduce and fix anatomically a complex posterior talar body fracture without the need of malleolar osteotomies.
Conclusion: The presented approach is a useful alternative to malleolar osteotomy to gain extensive access to the posterior portion of the talar body and, thanks to the Achilles tenotomy, also increases the maximal dorsiflexion of the ankle, thus enhancing the view on the articular surface. Performing an inverted Z-tenotomy in the frontal plane allows, in our opinion, for the preservation of a smooth posterior aspect of the tendon.

P75

Sport activity after AMIC-aided repair of osteochondral lesions of the talus

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Background: For the treatment of osteochondral lesions of the talus (OCLTs), autologous matrix-induced chondrogenesis (AMIC) is a safe 1-step procedure with good clinical and radiological results. However, data regarding postoperative sports activity after AMIC are limited.
Purpose: To identify significant factors influencing the rate of postoperative sports and recreational activities.
Methods: The sports and recreational activities of 60 patients (mean age, 34.9 ± 11.5 years) undergoing the AMIC procedure were retrospectively analyzed at a mean of 46.9 ± 17.8 months (range, 24.5–87.0 months) postoperatively. The visual analog scale (VAS) for pain score, Tegner activity scale score, activity rating scale (ARS) score, and satisfaction with surgery outcomes were assessed.
Results: Corrective calcaneal osteotomy was performed in 38 of 60 (63.3%) patients. Ligament repair was performed in 41 of 60 (68.3%) patients. The mean VAS score improved significantly from 6.9 ± 1.6 points (range, 5–10 points) preoperatively to 2.3 ± 1.9 points (range, 0–6 points) at latest follow-up (P\.001). No significant change in the mean Tegner activity scale score (3.3 ± 2.0 preoperatively to 3.4 ± 2.2 ostoperatively; P = .526) and the mean ARS score (2.6 ± 4.3 preoperatively to 2.3 ± 3.4 postoperatively; P = .874) was noted. The percentage of patients involved in sports activity before the onset of symptoms became significantly lower at the time of surgery (from 95.0% to 53.3%; P\ .001); no significant difference was noted postoperatively (from 53.3% to 58.3%; P = .663). No significant difference of the weekly sports frequency and the duration of sports activity was found postoperatively.
Conclusion: Patients undergoing AMIC repair of an OCLT participate at a similar low postoperative sports and recreational activity level compared with the preoperative level.

P76

Staged Treatment for a traumatic calcaneal defect using a vascularized iliac crest graft harvested through the Pararectus Approach

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For resilient reconstruction of the weight-bearing portion in large bone defects structural grafts are needed. The iliac crest provides an autologous graft with a large amount of cancellous bone. For larger defects a vascularized (deep circumflex iliac artery; DCIA) bony graft harvested from the iliac crest has been described. However, the high morbidity of the standard surgical access for the harvest limits its usability. Recently, the Pararectus Approach has been successfully used for the treatment of various intrapelvic pathologies with only minor access morbidity. Feasibility of harvesting a DCIA iliac crest graft through a Pararectus Approach has been proven in a recent cadaver study. This is the report of the first clinical application of this technique. A 68-year-old female sustained an open (Gustilo-Anderson type 3A) comminuted calcaneus luxation-fracture (Sanders type IIIBC) with a concomitant tibial pilon fracture (AO 43-C1) of the left lower extremity after a fall from great height. Initial treatment consisted of surgical debridement resulting in a big defect of the calcaneal body. The calcaneal tuberosity was reduced and fixated with screws. The hindfoot was spanned with an external fixator, a vacuum dressing applied and antibiotic treatment over six weeks initiated. After sterile conditions were obtained, osteosynthesis of the tibial pilon fracture was performed and soft tissue coverage was achieved with a free gracilis flap. Three months later, a vascularized (DCIA) cortical graft from the ipsilateral iliac crest was harvested using the Pararectus Approach and inserted into the bony defect. The supplying DCIA was connected to a branch of the posterior tibial artery and the vein to a vessel on the dorsal foot draining in the great saphenous vein (both end-to-end). By the time of discharge, the patient was immobilized with a lower leg cast and total weight relief for three months. At 12 weeks, the patient was pain free and showed no signs of infection. The hindfoot showed physiological alignment and height. Computer tomography (CT) showed proper integration of the graft. Protected full weight-bearing was initiated. Additionally, the donor site at the iliac crest had healed well without pain or signs of herniation. This is the first case of a bony reconstruction using a DCIA iliac crest graft harvested through the Pararectus Approach. Twelve weeks after surgery, CT scan showed partial integration of the graft. There were no donor-site complications.

P77

Clinical and radiological outcome of metatarsophalangeal hemi-arthroplasty for the treatment of hallux rigidus

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Introduction: Driven by the patients request for reliable pain relief while preserving a mobile first metatarsophalangeal joint (MTP-I) several prosthetic designs were developed. Early MTP-I prosthetic designs resulted in high failure rates. The purpose of this study is to examine the function, pain, satisfaction, return to sports, and radiological outcome after MTP-I hemiarthroplasty.
Methods: After approval by the Cantonal Ethical Committee we identified 15 patients that underwent MTP-I hemiarthroplasty (Arthrosurface, HemiCAP®) in our institution between January 2011 and February 2016. Two patients were excluded from the study because an additional TMT-I arthrodesis was performed. Patients were invited to participate in an outcome study by questionnaires for subjective/objective outcome, and clinical/radiographic follow-up (FU). Two patients were lost to FU.
Results: 11 patients (11 feet; 56 ± 15 years) returned the questionnaires. The mean follow-up was 17.8 ± 14 months. 7/11 patients were satisfied with the postoperative result. The visual analog scale for pain (VAS, 0-10) decreased significantly from 7 ± 2.4 preoperative to 3.7 ± 3.1 postoperative (P = 0.042). Four patients were taking pain medication at the last FU. The mean passive range-of-motion (ROM, degrees) of the MTP-I preoperative was 31 ± 10, intraoperative after implantation of the hemiarthroplasty and closing of the joint capsule 93 ± 18, at the 6 weeks FU 28 ± 15, at the 3 months FU 37 ± 16, and at the final FU 37 ± 18 (P = 0.26). During the FU period a therapeutic infiltration of the MTP-I was performed in 5 patients, mainly for loss of range of motion. In one patient an additional

open adhesiolysis of the MTP-I was performed. The mean American Orthopaedic Foot & Ankle Society (AOFAS) forefoot score increased significantly from 48.9 ± 14.3 preoperative to 71.5 ± 15 points at the last FU (P = 0.033). Seven patients were able to perform sport at the same or higher level at the final FU compared to preoperative. In none of the patients radiological loosening of the implant was observed at the final FU. The sagittal and coronal alignment of the first ray was not significantly changed from pre- to postoperative.
Conclusion: Although MTP-1 hemiarthroplasty demonstrates a significant pain reduction at a mean follow-up of 17.8 months the ROM of the MTP-I was not restored to anticipated levels and in half of all patients a therapeutic infiltration had to be performed postoperative.

P78

Mid- to Long-Term Results of Total Ankle Replacement in Patients with Hemophilic Arthropathy: a 10-year follow-up

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Introduction: Hemophilic arthropathy is caused by recurrent spontaneous hemorrhaging into so-called target joints. The ankle is one of the most commonly affected sites. Symptoms comprise joint pain and deformity paired with loss of function. Current literature still refers to arthrodesis as the procedure of choice for treatment of advanced articular destruction. Recently, total ankle replacement (TAR) has gained acceptance as an alternative. The objective of this study was, to investigate the mid- to long-term results after TAR in patients with hemophilic ankle arthropathy.
Materials and Methods: Between 1998 and 2012 17 TARs were implanted into 14 male patients (3× bilateral). 3 revisions with component removal were performed. 2 patients were lost to follow-up. 9 patients with 12 unrevised TARs were available for follow-up exams. Preoperative hemophilic/viral status, additional surgical procedures and intra-/postoperative complications were determined. Implant survival was estimated using Kaplan Meier analysis. The outcome of 12 ankles was assessed using pain and satisfaction scales, the AOFAS hindfoot score, and the SF-36. Pre- and postoperative ROM were statistically compared. Radiographic evaluation of pre- (Pettersson score) and follow-up radiographs was conducted.
Results: 17 ankles received TARs at an average age of 43.4 years (27.4–57.6). The Pettersson score was 7.8 (5–10). With 3 cases revised and 2 lost to follow-up, a total of 12 ankles were seen at 9.6 years (3.3–17.8) postoperatively. The level of satisfaction was rated 76% (50–100), that of pain 2/10 (0–6) on the VAS. ROM had increased significantly (p = 0.037). The SF-36 summary scores were not lower than in a sex-/age matched standard population. The AOFAS hindfoot score averaged 81 points (73–90). All follow-up radiographs displayed component loosening or periprosthetic radiolucency. Implant survival based on Kaplan Meier analysis was estimated to be 94% at 5, 84% at 10, and 67% at 15 years.
Conclusion: TAR in the setting of advanced hemophilic arthropathy is a viable treatment option with favorable clinical mid-/long-term results. As opposed to ankle arthrodesis, mobility of the ankle joint is preserved which may be advantageous concerning patient wellbeing. However, implant survival appears to be shorter than in individuals without coagulopathies, while patient age at surgery tends to be younger. The necessity for revision surgery is likely to arise for a majority of these patients.

P79

Venous thromboembolism prophylaxis with rivaroxaban in elective foot and ankle surgery

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Introduction: Oral application for prophylaxis of venous thromboembolism (VTE) after total hip and knee arthroplasty has high acceptance among patients due to its non-invasive nature, when compared to traditional subcutaneous application of lowmolecular-weight heparin (LMWH). Approximately 10% of the patients in our clinic receive oral thrombosis prophylaxis (rivaroxaban), the remaining patients receive subcutaneous prophylaxis with LMWH (dalteparin). However, no clinical data exists describing the use of oral prophylaxis in elective orthopedic foot and ankle surgery. The aims of this study where: 1. To assess the incidence of VTE after oral prophylaxis after elective foot and ankle procedures. 2. To identify risk factors for VTE after oral prophylaxis after elective foot and ankle procedures.
Methods: A retrospective chart review of patients undergoing elective foot and ankle surgery between January 2010 and 2013 was performed. The type of medicamentous thrombosis prophylaxis was noted. All patients receiving oral antithrombotic medication (rivaroxaban, XareltoÂ©, Bayer, Germany) were included in the study. Location, length and type of surgery and tourniquet time were assessed. Co-morbidities (e.g. diabetes, coagulopathy, ASA classification) were noted. Patients previously treated with phenprocoumon or clopidrogel were excluded. A phone interview was performed and patients were asked whether a thromboembolic incident occurred or not. If an incidence was reported, the report of the diagnostic findings was obtained from the general practitioner.
Results: 450 patients were included. Two thromboembolic incidents occurred (0.4%; deep venous thrombosis confirmed by ultrasound). Both patients had a history of previous deep venous thrombosis and a positive family history for VTE. Due to the percentage of patients with VTE, a multivariate analysis could not be performed.
Discussion and Conclusion: The incidence of VTE after oral thrombosis prophylaxis with rivaroxaban is low and comparable with the incidence after subcutaneous application of LMWH.

P80

Medial swivel dislocation of the talonavicular joint

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Introduction: Medial swivel dislocation, a variant of a subtalar dislocation is uncommon. We present a case successfully treated with this rare lesion.
Case report: A 54 years old female presented one week after a low energy trauma to her left mid foot. She had pain, swelling around the ankle, and was unable to bear weight on the left foot. Clinical examination revealed moderate swelling and tenderness in the mid foot region. Plain radiographs and CT-scan showed a talo-navicular dislocation with osseous impaction of the head of the talus. Open reduction and fixation was performed. The osteochondral lesion of the talus was fixed with two solitary 1.5 mm cortical screws and a temporary talo-navicular arthrodesis with a 2.0 mm plate was performed. The patient was allowed to walk with partial weight-bearing with a short leg cast for 8 weeks. After 3 months, the plate was removed; the patient received physical therapy for improvement of proprioception and muscle force. After one year, the patient was completely free of pain; the mobility of the subtalar joint and the muscle forces were symmetric. On the radiographs a small collapse of the head of the talus without clinical consequence was detected.
Conclusion: The described injury is characterized by a dislocation of the talo-navicular joint. The calcaneo-cuboid and the subtalar joints remain intact. During accident, the foot makes a typical rotational movement consisting in a pure supination and adduction without any additional inversion or eversion. The axis of rotation is the interosseous talo-calcaneal ligament which remains intact. This lesion is very rare and there are only 3 cases reported in the literature. Diagnosis can be easily missed. Thus, careful analysis of all plain radiographs is mandatory, and imaging has to be completed with a CT-scan.

P81

Biomechanical Comparison of Suture Material (PDS CTX vs MonoMax) for Achilles Tendon Reconstruction (Adelaide Suture-double strand cross locked suture-technique)

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Background: A possible treatment of the Achilles tendon rupture is the surgery, where the tendon is sutured together. Within our project we were testing the tensile strength of different type of sutures of cadaver Achilles tendon specimens.
Methods: Ten pairs of fresh frozen Achilles tendons were obtained from human donors aged 41–85. The Achilles tendons were frozen at –20 °C after dissection to preserve the biomechanical properties of the tissue. At the test day the tendons were thawed at room temperature and final preparations done. About 4 cm of both ends of the tendon were fixed between two stainless steel clamps with rounded edges, to prevent the tendon from being damaged at the fixation points. The clamps were cooled using liquid CO_2, to freeze the tendon to the clamps, giving it more stability and preventing it from slipping out of the clamps during testing. Before testing, two reflecting markers were fixed to the tendon about 2 cm below resp. above the clamps, using cyanoacrylate glue. These four markers were tracked during different loading conditions with six high-speed digital cameras. The displacement of the markers

and the force measured by the load cell were recorded synchronously with the motion analysis system. The native tendon was loaded under tension until failure in a testing machine. The following loading cycles were performed: Preloading with 1 Hz between 100 and 800N over 20 cycles. Loading until failure with 10kN/sec. Suturing of the ruptured tendon with double strand cross locked suture-technique a) B Braun; MonoMax HRT 40s; b) Ethicon; PDS CTX; Size: 1 (PDS). Preloading with 1 Hz between 50 and 100 N over 20 Cycles Loading until failure with 10kN/sec.
Results: The measured force at the rupture ranges between 2408N and 5972N (tab. 2). The area of failure varies with in the different tendons. The maximal forces in the sutured tendons occurring at the rupture were for the BB-suture between 144 N and 232 N (Mean 197 (SD 67) N) and for the PDS-suture between 158 N and 226 N (Mean 194 (SD 70) N).
Conclusion: The test showed that, the rupture occurs not always at the same location and the force is quit varying depending on the type of rupture. A mid tendon rupture was in the range of 5000 to 6000 N, therefore a good fixation in the clamp is very important. Further the load to failure of the sutured tendons is around 200N. Therefore it can be concluded, that the BB Suture and the PDS-Suture have a similar load until failure for the given test setup.

P82

An original technique to address an intermetatarsal coalition

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Introduction: Coalition of the forefoot is rare. There are less than ten reports in the literature. Therefore, there is no guideline for their management and every case has to be treated individually. We report a case and the surgical technic we used to treat it.
Case Presentation: A 18 yo man has been suffering 2 years from pain at the lateral border of the right 5th metatarsal head, in his sports shoe. Physical examination revealed a painful hyperkeratosis at the lateral aspect of the 5th metatarsal head, a varus deviation and stiffness of the 5th toe, creating a conflict with the 4th toe. The x-rays showed a coalition between the diaphysis of the 4th and the head of the 5th metatarsals with a distal varus deviation. The 5th metatarsal head was deviated towards plantar by 11mm in relation to the 4th metatarsal head. The goal was to narrow the forefoot, to elevate the 5th metatarsal head, and to suppress the conflict between the 4th and 5th toes. The biomechanical requirement was to avoid any modification of the healthy cuboïdo-metatarsal joints and to preserve the attachment of the short peroneal tendon. We decided, to resect the coalition, and to realize a suspended distal osteotomy of the 5th metatarsal head. The distal 5th metatarsal was derotated into valgus and fused to the previous basis of the coalition on the 4th metatarsal. An arthrodesis between the bases of the 4th and 5th metatarsal was performed. The patient was allowed to bear weight as tolerated in a postoperative shoe with rigid rocker bottom sole for 6 weeks.
Outcome: At 6 months after surgery, the patient had no complaint and played basketball again. There was no need for specific shoe or insole. The final radiographs showed a complete consolidation with adequate realignment of the forefoot.
Discussion: In this case, the main problem was the width of the forefoot, creating a conflict with the shoe. We shrunk the forefoot and created a harmonious arch of the metatarsal heads. We didn't touch the 4th ray because it was clinically well aligned. Metatarsal coalition is rare with only 8 isolated non-syndromic cases reported in the literature. If surgical treatment is required, several techniques are suggested in the literature, all with pretty good results. To our knowledge, the technique proposed here has never been described before and adds, therefore, a possible alternative, to the few previously reported surgical solutions.

P83

Epiphysiolysis type Salter I of the medial clavicle. A case report

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Introduction: Epiphysiolysis of the medial clavicular end or dislocation of the sterno-clavicular joint (SCJ) are rare lesions during childhood. The clavicle is the last bone to ossify at its medial part at the age of 17 to 20 years of age. The osseous fusion of the growth plate takes place at the age of 23 to 25 years. On standard radiographs it is difficult to distinguish between a true SCJ dislocation and a displaced medial epiphysiolysis type Salter I or II.
Case report: A 13 year old boy presents in the pediatric emergency room with upper thoracic pain. He indicated a fall during a soccer play and a severe compression injury to his thorax when another player felt on him. Clinically, no neuro-vascular troubles or dyspnea were present. Conventional radiographs showed a posterior dislocation of the medial clavicle, confirmed by a CT-scan. Intraoperatively, an epiphysiolysis type Salter I of the medial clavicle was found. Open reduction was performed and the medial end of the clavicle stabilized with a figure-of-eight Fibertape. The patient was immobilized with a posterior figure-of-eight bandage for 6 weeks. At 12 weeks, the patient was asymptomatic, the range of shoulder mobility was symmetric, the body-cross test was negative, and radiographs revealed healing in correct length of the clavicle and correct position of the medial epiphysis.
Conclusion: Epiphysiolysis of the medial end of the clavicle or posterior SCJ dislocation is a major lesion which can be complicated by additional vascular injury. Closed reduction attempts are unsuccessful. Thus, open reduction and fixation with trans-osseous sutures should be performed. The aim of the fixation is to obtain an anterior traction of the medial clavicle avoiding a posterior re-dislocation.

P84

Mechanism and predisposing factors for non-traumatic proximal tibial epiphysiolysis in adolescents during sports activities. A retrospective analysis of cases and a systematic literature review

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Introduction: Non-traumatic proximal tibial epiphysiolysis (NTPTE) can have debilitating consequences for young athletes. The mechanism and predisposing factors for this lesion have yet to be determined. To find a common denominator and a biomechanical explanation for NTPTE we conducted a retrospective analysis of 15 cases in combination with a systematic review of literature.
Methods: A retrospective review of medical charts was performed to identify all NTPTE between 2003 and 2012. Records were screened for patient age and gender, sports activity, mechanism of injury and treatment protocols. Additionally a literature review (MEDLINE/PubMed database, the Cochrane Library, online search engines) was conducted.
Results: Medical charts of 14 adolescents (15 Salter-Harris I and II fractures) were analyzed. The literature review revealed additional fractures. The predominant mechanisms were landing from a jump, take-off for a jump, stop and go movements and eccentric muscle contraction with the knee in flexion. The main sports-activitie implicated in these injuries was basketball.
Conclusions: Landing from a jump with a decreased knee and hip flexion movement increases tensile forces on the proximal tibia epiphysis. During physiological epiphysiodesis the growth plate displays an increased vulnerability and such increased tensile forces can lead to a growth plate failure. Neuromuscular fatigue can alter coordination and proprioceptive accuracy during landing from a vertical jump and thus affect sagittal shock absorption. In our opinion, trainers should instruct young athletes in techniques that help avoiding uncontrolled high impact landings.

P85

Salter-IV fractures of the medial femoral condyle in a 15 year old boy. A case report

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Introduction: Hoffa Fractures are rare injuries of the femoral condyles, which typically occur on the medial side. Since there is a lack of bony contact of the distal fragment, these injuries are associated with an increased risk of pseudarthrosis or avascular necrosis. Therefore, this intraarticular fracture has to be treated by anatomical reposition and stable fixation under compression. We report on a 12-year old boy who presented with a Salter-IV-fracture of the medial femur condyle. The fracture line was not in the sagittal plane, like common Salter IV fractures, but in the coronar plane, similar to a Hoffa fracture of an adult. This type of fracture is rare and – to our knowledge – hardly described in children.
Methods: In December 2016 a 15 year old boy presented to our emergency unit after he was hit by a bus. No additional injures, no known comorbidities. Physical examination was inconclusive because of pain. After conventional X-ray, a CT was performed and the fracture

was diagnosed. We saw the indication for an arthroscopically assisted fixation of the medial femoral condyle with cannulated screws.
Results: We were able to achieve an anatomical reposition with compression of the fracture. For the aftercare, we applied a thigh cast for six weeks. We will be presenting the results of clinical and radiological follow-up.
Discussion: Fractures of the medial femoral condyle are rare. Since these fractures are intraarticular, a correct anatomical reposition is necessary. Arthroscopically assisted internal fixation is recommended for adults. After extensive literature research we were able to identify only one case in which this fracture was reported in a child. There, an open procedure was performed. We anticipate that arthroscopically assisted reduction and internal fixation is leading to less tissue damage than open surgery.
Conclusion: In this case, treatment of a Hoffa fracture could be performed by arthroscopically assisted internal fixation, comparable to the treatment of Hoffa fractures in adults.

P86

Heptadactylia: An unusual case of foot central polydactyly

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Introduction: We described original case of heptadactylia of the foot. Polydactyly is a prevalent birth anomaly observed in 1/500 living birth and is characterized by supernumerary digital or metatarsal toes. Polydactyly is generally classified into three major groups: preaxial (medial ray, 15–17%), post axial (lateral ray, 80%) and central polydactyly (3–6%). The duplication may appear at the distal and middle phalanx or at the whole digit and metatarsal. Central polydactyly with duplication of the metatarsal is really unusual.
Methods: A non-ambulatory 11 months old girl presented with seven toes on his left foot. The right foot have normal appearance with a metatarsal arch measured at 44 mm of width at the level of the heads. On the left side, the metatarsal arch is measured at 53 mm. Heptadactyly was associated with elevatus and clinodactyly of third toe, hypoplasia of the second toe. At standing, there is a grip on the ground of all the toes except O3 which remains in elevatus. There is no other congenital deformity at the clinical exam. The supernumerary toes made it impossible for the child to wear standard shoes. Foot radiographs revelated the presence of seven complete rays. Every toe has phalanx and metatarsal ray.
Results: Decision was made for surgical treatment and resection of the second and the third ray; the two most malaligned toes in our consideration. We perform an interdigital incision on dorsal approach of the foot. We reconstructed intermetatarsal ligament of the first and the fourth metatarsal using sutures on the ligament and a K-wire to stabilize the foot. Then we make bandage lightly with cotton roll, and we applied a complete plaster of Paris cast to reduce the mobility of the reconstructed interdigital ligament. We removed the plaster and the k-wire after 4 weeks of non-weight bearing. An orthosis was then introduced. The patient proceeded to heal unremarkably, and at 2 months postoperatively, she displayed a well-healed postoperative scar and no evidence of any complications related to the surgery. A harmonious toe's cascade was restored.
Conclusion: We demonstrate that management of polydactyly of the foot requires careful preoperative assessment, including radiographs and photography. A good clinical exam in evaluating medial polydactyly improves type-specific description, which may, enhance the evaluation of surgical treatment. We recommend that surgical treatment be planned in childhood before the age of walking.

P87

Excellent outomes of open reduction, ulnar osteotomy and external fixation without ligament repair for missed Monteggia lesions in children

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Background: Missing an acute Monteggia fracture can, over time, lead to functional limitations by a decrease in elbow range of motion (ROM), valgus deformity, and onset of pain. Surgical reconstruction of missed Monteggia lesions is still debated, especially if the initial trauma was way back in time. The purpose of this study is to present our results of children with a neglected Monteggia fracture who were surgically treated by mini-open ulna osteotomy (OT), open reduction of the radial head and fixation with an external fixator without repair of the annular ligament.
Material and Methods: We retrospectively analyzed 29 paediatric patients, 17 girls and 12 boys, all of them treated at our institution in a standardized way for missed Monteggia fractures. Exclusion criteria were convex deformation of the radial head, grade III and IV cartilaginous lesions of the capitellum humeri and dislocation of the proximal radius into the ulnar compartment with rupture of the interosseous membrane.
Results: Between 1998 and 2014 a total of 29 patients were treated for a missed Monteggia fracture at our institution. Average age at the time of surgery was 9.4 years (5–15) with an average delay of 25 months (3–111) between surgery and initial trauma. In 26 patients a stable reduction of the radiocapitellar joint could be achieved. Three patients showed a re-dislocation of the proximal radius on follow-up. Two of them were re-operated with increased flexion at the ulnar OT site to finally achieve stable reconstruction. In the other case of a non-ambulant patient with myelomeningocele without elbow pain and adequate ROM the proximal radius was left dislocated. Before operation 20/29 patients had limitation of elbow ROM >10° compared to the unaffected side, with ROM remaining slightly limited in 10/29 after operation. Maintenance of a normal ROM, restoration of a normal ROM, or improvement of a restricted ROM was achieved in 93%.
Conclusion: Surgical treatment by ulna osteotomy, open proximal radius reduction and external fixator for missed Monteggia fractures shows excellent results in regard of elbow joint reconstruction and improvement of range of motion.

P88

Fixation of an intercondylar eminentia fracture in the child with a hock shaped Kirschner wire minimal invasive

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Background: Intercondylar fractures of infantile patients are not frequently. The operative technic can be difficult for the untrained surgeon. In most cases the injury is presented in an avulsion fracture on the tibial insertion with the classification of Meyer and McKeever type II. We try to explain a simple method with standard surgical treatment for the reconstruction of the ACL.
Methods: We use standard anteromedial and anterolateral arthroscopic portals to reduce the fracture. In most cases the medial meniscus resists repositioning. Without need of resection of the intermeniscal ligament we reposition the fracture with a small arthroscopic hook and hold it in position. A small incision is made on the medial side of the tibia metaphysis and the tibial aimimg device for the standard ACL reconstruction is positioned through the medial arthroscopic portal and reduce the fracturer. Over this aming device you can bring in a 1 mm k-wirer. With a standard needle holder over the anterolateral portal bend the k-wire 180° intraarticular and push it distal to fix it in the fragment. The metaphyseal fixation is made with a standard 3.5 mm AO screw. Postoperative Care with a Fixed brace for 6 weeks. After consolidation you can remove the screw and the Kirschner wire under short anesthesia and incision on the metaphysis without opening the joint.
Results: In our Patients we found no loss of reduction. After 6 Weeks in a fixed brace we started to mobilize the knee without a limit. All patients returned to the previous activity level and there was no clinical relevant instability of the knee.
Conclusion: We see the advantages of the described method above in the technically less demanding execution as well as in the gentle and only minimally invasive technique. The physeal growth plate, which is only bridged by a 1.0 mm Kirschner wire, is significantly less damaged than by the osteosynthesis with screws.

P89

Management of Congenital Pseudathrosis of the clavicle – a single-centre experience

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Background: Congenital pseudarthroris of the clavicle (CPC) is very rare. It predominantly presents at the right side, in the middle part of the clavicle. As children are often asymptomatic, operative treatment is debatable.
Methods: In this retrospective study we present our single-center experience of surgical management of CPC. We analyzed all children operated between 2004 and 2012 with resection of the CPC, bone grafting with a nonvascular iliac crest and plate fixation. Exclusion criteria were traumatic or obstetric fractures of the clavicle and children with neurological or genetic disorders. The follow-up visits 6 weeks,

3 months and 6 to 12 months postoperative included clinical as well as radiological examination.
Results: 7 patients with 8 clavicles were operated with a mean age of 7.1 years (5–8 years). Of these, 4 were girls and 3 boys. In all operated children, the diagnosis of CPC was made before the age of 5 years. At the time of diagnosis, they presented with an asymptomatic mass or swelling over the clavicle with normal range of motion. Mean follow-up was 7 years (4–10 years). One patient was affected bilaterally with challenging surgical management. One patient had delayed union. 85% of our patients showed good functional results with complete radiographic consolidation at a mean of 8.5 months (3–25 months). At the 6–12 month follow-up all children had good clinical function with a mean Constant Score of 94 points (88–98 Points). No late fractures, no wound complications occurred. 3 children had severe pain at the donor site in the early postoperative period, but at the 6 weeks follow-up none of these children had persistent donor-site morbidity.
Conclusion: The operative treatment with resection of the CPC, interposition of nonvascularized bone graft from the iliac crest and plate fixation, seems to be successful in early childhood. We advise operative treatment between 5 and 7 years of age.

P90

Low Budget Plating for hemiepiphyseodesis around the knee in expensive medical times

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Purpose: To retrospectively review our results with special focus on implant related failures when using a simple two hole plate with solid cancellous screws for hemiepiphyseodesis around the knee in the adolescent.
Patients and method: Since 2007 we have used a simple two hole titanium foot plate 711 times in the femur and the tibia or in both . There were 356 hemiepiphyseodeses in the tibia and 355 in the femur in 338 patients. Of these there were 144 girls and 194 boys. The average age at implantation of the plates was 12 years in girls and approximately 13.5 years in boys. The main indication was bilateral valgus deformity of the knee with a lateralization of the mechanical axis of over 12 mm, less common was the treatment of a medialization of the mechanical axis in varus deformity of over 16 mm. For fixation of the plate we used simple solid cancellous 4.0 screws. The surgical technique is little different to that used with cannulated screws, however faster and with less radiation time.
Results: We observed only few device related problems. In the beginning, when we used titanium screws we had to face some breakages of the screws during explantation, but since we used solid steal screws no such breakages were seen anymore. A loosening of the screws was never seen. The plate never broke, even not in severe deformities and long term implantation.
Conclusion: Based on our experience, especially for the experienced pediatric orthopaedic surgeon a simple two hole plate fixed with solid cancellous screws is a perfect device for growth guidance in the adolescent patient. It is not only less expensive but furthermore quicker to implant with less radiation time and has no higher (and probably a lesser) complication rate in comparison to usually used plate systems.

P91

Isolated diaphyseal fracture of the fibula in a 6 year old child. A case report

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Introduction: Children are at high risk of injury with up to one of every four children sustaining an injury annually; fractures are associated with 10% to 25% of these injuries and are sex and age related. Fractures of the lower leg in children are common. 15% of pediatric long bone fractures involve the lower leg, mostly affecting the tibia shaft (55%); isolated fibular fractures occur in 13% of cases, but most of them are localized in the distal epiphysis. However, isolated greenstick diaphyseal fibula fractures are rare. Very little has been described in the literature so far, especially when it comes to treatment of such fractures
Objective: We present a case of isolated greenstick diaphyseal fracture of the fibula in a 6 year old child. Classified as AO 42f-D/2.1.
Case report: A 6 year-old child fell from the trampoline and landed with a direct blow to his left fibula on the metal frame. An isolated in valgus impacted greenstick fracture of the fibula shaft AO 42f-D/2.1 was diagnosed with a 20° deformation. For reduction and fixation a 2.0 mm titanium elastic nail (TEN) was inserted in a retrograde fashion. The postoperative radiographs showed an anatomical reduction of the fracture. A walking cast was applied for 5 weeks. Further radiographs were done at 1 week, 5 weeks, 7 weeks and 7 months respectively. The TEN was removed after 7 months.
Results: Post-operative follow up showed fast consolidation of the fracture without secondary displacement.
Conclusion: In order to prevent valgus deformity we recommend treating isolated diaphyseal fractures of the fibula in children with an intramedullary titanium elastic nail. Though this was our only case we can strongly recommend the use of this technique because of its simplicity and good functional outcome.

P92

Guided growth with tension band plate or definitive epiphysiodesis for treatment of limb length discrepancy?

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Introduction: It is not exactly known whether guided growths or definitive epiphysiodesis techniques are superior in treating limb length discrepancy (LLD).
Methods: Medical records of patients between 2006 and 2012 were reviewed treated either with tension band plating as a guided growth technique (temporary epiphysiodesis) or with a percutaneous drilling technique (definitive epiphysiodesis) because of LLD. Surgery was performed around the knee – in the distal femur alone, the proximal tibia alone or in both. The minimum follow-up was 12 months. Radiographic measurements were performed by two independent reviewers.
Results: Thirty-eight patients were included, 17 treated with temporary epiphysiodesis and 21 with definitive epiphysiodesis. There were no statistically significant differences for age, sex, preoperative LLD and follow-up time. Average follow-up was at 578 days. The reduction of the LLD in 12 months was 5.7 mm in patients treated with temporary epiphysiodesis and 8.4 mm with definitive epiphysiodesis, respectively. This difference was, however, statistically not significant. In both groups LLD could be statistically significant reduced after 12 and 24 months. Intra- and interobserver reliability of the measurements was excellent.
Conclusion: As in earlier studies supposed, temporary epiphysiodesis with tension band plating seems to correct LLD less powerful compared to definitive percutaneous epiphysiodesis. However, in the present study the differences of LLD correction were not statistically significant.

P93

Plate fixation for irreducible proximal humeral fractures in children: a case series of six patients

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Introduction: Recommended treatment for severely displaced proximal humeral fractures in children is closed reduction and percutaneous fixation by K-wires or intramedullary nailing. We present a case series, in which closed reduction was not possible due to tendinous or osseous interposition within the fracture.
Methods: From September 2014 to September 2016, 6 children/adolescents (one female, age range 8 to 16 years) were treated surgically for severely displaced proximal humeral fractures. All patients had fractures with a dorsally dislocated humeral head. There were five type III and one type IV fracture according to the Neer-Horowitz classification. In all patients an attempt of closed reduction was made. Five patients were surgically treated with direct open reduction and internal fixation with plate fixation, one patient was initially treated with closed reduction and percutaneous pinning, due to secondary displacement an open reduction and second operation with internal fixation was necessary. The humeral head was fixed with an angular stable T-plate without affecting the growth plate. Plate removal was scheduled 3–4 months postoperatively in all cases.
Results: In all six cases dorsal dislocation of the fracture was not reducible due to interposition of tendinous or osseous structures. In two cases the long biceps tendon interposed, in two cases periosteal-tissue, in one case a bony fragment and in one patient the long biceps tendon and the conjoint tendons. Postoperative follow-up after a mean of 6 months showed excellent clinical results with a mean Constant

score of 92 (range 88 to 95). Radiologic follow-up showed in all patients early consolidation and no loss of reduction.
Conclusion: If a proximal humeral fracture is not reducible by closed means, a tissue entrapment (mostly biceps tendon) should be considered. Treatment with open reduction and plate fixation yields excellent clinical and radiological results.

P94

Infective spondylitis with epidural abscess-formation caused by Aerococcus urinae: a case report

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Introduction: In predisposed elderly, Aerococcus urinae is an underestimated urinary tract pathogen. Very few cases of balanitis, lymphadenitis, endocarditis and spondylodiscitis have been reported. In our case, infective spondylitis with epidural abscess-formation caused by A. urinae was successfully treated operatively in combination with short-term antibiotic treatment.
Methods: A 68-year-old male with lumbar pain received facet joint infiltration L4/5. 4 days after infiltration and escalating pain momentum laboratory studies showed leukocytosis and elevated CRP. Blood cultures remained sterile. MRI yielded intraspinal epidural abscess-formation L5/S1. After microscopic decompression L5/S1 because of severe pain, cefuroxime IV as empiric antibiotic therapy was started. A. urinae was grown in all biopsies. Antimicrobial treatment was changed to intravenous penicillin G and gentamicin. Urinary retention and prostate hyperplasia was found as presumed source, however, urinary status 4 days postoperatively was normal. No endocarditis was detected on serial transthoracic echocardiographies. 2 weeks post-surgery when inflammatory parameters were normal, wounds dry and the patient fully mobile, antibiotics were changed to ceftriaxone. After another 2 weeks, ceftriaxone IV was stopped and clindamycin was given orally for further 3 weeks. After an antibiotic free interval of 4 weeks, transurethral prostate resection was performed in an external clinic.
Results: 1 year after surgery, the patient presented in excellent condition without any functional impairment. No progression of osteochondrosis was detected radiologically.
Conclusion: To our knowledge, only 5 cases of spondylodiscitis by A. urinae have been published so far but none with an epidural abscess. In our case without endocarditis, a treatment period of 7 weeks (4 weeks IV and 3 weeks PO) in combination with surgery seemed adequate. Even though antibacterial synergy is not present in all known isolates of A. urinae, a combination therapy of penicillin G and gentamicin was applied, followed by ceftriaxone once daily IV and clindamycin orally as an outpatient. Thus, surgical therapy of epidural abscess-formation in combination with short-term use of antimicrobial treatment proved to be effective and adduced complete healing.

P95

Preoperative decolonization and surgical site infections – a prospective randomized trial (DECO-SSI trial)

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Background: Surgical site infections (SSI) are major postoperative complications and mostly due to patient's endogenous germs like Staphylococcus aureus. These infections are a future health care challenge, especially in orthopaedic surgery where the number of periprosthetic joint infections increases with rising numbers of implants and multimorbid patients. Preoperative decolonization procedures showed an overall trend in lowering SSI, but in orthopaedic surgery randomized controlled trials and evidence-based consensus about decolonization procedures are lacking.
Design: In our controlled prospective randomized single-blind trial we assess primarily the effect of preoperative decolonization of nasal Staph. aureus carriers in patients undergoing an elective orthopaedic surgery. Also, in a non-Staph. aureus carrier group we will study the effect of preoperative skin decolonization. Number of SSI in all study arms will be monitored.
Methods: 2700 patients aged >16 years undergoing an elective orthopaedic surgery in a primary care hospital are screened before surgery for nasal Staph. aureus carriage. Carriers are randomized into control and intervention arms. Intervention consists of a 5-day course with daily chlorhexidine sol 4% showers and twice daily mupirocin 2% nasal ointment application. The non-carrier group is also randomized into control and intervention arms. Intervention consists of a 5-day course with daily chlorhexidine sol 4% showers only. In both, primary outcome is overall incidence of SSI at 3 months. Secondary outcome is early (1 month) and late (3 months) SSI. Tertiary, total screening costs will be surveyed.
Results: To date we have performed 897 nose swabs. Interestingly, we note a high carrier rate with 35% of patients testing positive for Staph. aureus. Only one case among the 897 patients had MRSA carriage. In summer 2017 we expect to perform the interim analysis. The final analysis is scheduled in December 2018.
Conclusion: Prevalence of Staph. aureus carriers in the region of Bern is higher than elsewhere if compared to current literature. Reasons for this local high prevalence and its impact on the occurrence of SSI need to be studied further. The DECO-SSI trial is the largest prospective ongoing trial to date to investigate decolonization and the incidence of SSI in a heterogeneous population of orthopaedic patients. We would like to present our study protocol, characteristics of carriers and non-carriers and preliminary results.

P96

Treatment of periprosthetic shoulder infections using antibiotic loaded cement spacer

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Background: The treatment of periprosthetic shoulder infections (PSI) with two-stage revision arthroplasty using an antibiotic loaded cement spacer is beside the single-stage revision the most common strategy to successfully treat low-grade infections. Nevertheless, the available data about restoration of shoulder function after cement spacer treatment is scarce. This study aimed to analyze the eradication rate of infection and the functional shoulder restoration after two-stage revision arthroplasties using antibiotic cement spacer.
Methods: We retrospectively searched for patients with a PSI treated with a 2-stage exchange using an antibiotic spacer between 2000 and 2013. The infection eradication rate 2 years after reimplantation was assessed as the primary endpoint and the clinical outcome obtained with the Constant and Murley Score, the patient satisfaction and the subjective shoulder value at the last follow-up visit was defined as the secondary endpoint.
Results: Between January 2000 and December 2013 48 patients underwent a two-stage revision arthroplasty using an antibiotic loaded cement spacer. 10 patients were lost to clinical follow up. The infection eradication rate was 95%. The complication rate was 58% and the revision surgery rate 38%. In patients who were definitely treated with RTSA (n = 23) the CS and RCS improved the most from 31 (2–81) to 51 (14–78) points and from 37 (2–95) to 61 (18–100) % ($p < 0.01$). Those, who were treated with HA (n = 6) improved from 22 (7–42) to 24 (11–33) points respectively from 25 (9–45) to 28 (13–45) % and those, where the spacer was left in place (n = 9) had a final CS / RCS of 35 (23–45) and 42 (29–59) %. Patients with a 2-stage revision with a definitive reimplantation of a RTSA with 5 or more surgeries before the 2-stage revision showed a significantly lower mean CS.
Conclusion: The infection eradication rate of periprosthetic shoulder joint infection after the use of an antibiotic loaded cement spacer is 95% in our cohort. Two-stage revision with re-implantation of a RTSA allows the best restoration of shoulder function in our series. Multiple prior surgical interventions worsen the functional outcome of patients with a reimplantation of a RTSA.

P97

Can a single positive sample of Propionibacterium acnes from revision arthroplasty be ignored?

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Introduction: Propionibacterium acnes (P. acnes) is a skin commensal but also known to cause invasive infections such as periprosthetic joint infections (PJI). Extended cultivation times up to 10–14 days increase the likelihood for detection of P. acnes but also the chance of cultivating a contamination. Although according to the literature a single positive sample is typically judged as contamination, the surgeon feels uncertain whether longtime antibiotic treatment is favorable for an infection free outcome. The aim of this study was to evaluate the outcome of patients with a single positive sample for P. acnes in cases without previous signs of infection.

Methods: In a retrospective analysis from 2005 to 2014, patients with at least one positive sample for P. acnes in intraoperative tissue or sonication fluid in presence of an arthroplasty were identified. Only one positive of at least three taken specimens was considered a contamination whereas two or more positive samples were defined as an infection. Patients with more than one positive sample and outcome less than 2 years were excluded. Surgical, antibiotic treatment and outcome were evaluated. Relapse of infection was defined as growth of P. acnes in ≥2 samples during follow-up.
Results: In total 55 patients with a positive sample for P. acnes were identified 27 cases (27 patients) were diagnosed as contamination (11 shoulders, 9 hips, 7 knees) with no previous sign of infection. All received surgery and 20 (74%) were also treated with antibiotics for at least 6 weeks. In the shoulder 1 patient (9%) had a two-stage, 8 a one-stage exchange (73%) and 18% a debridement with retention of the implant. 7 received antibiotics and 4 not. 3 total hips were exchanged two-staged (33%) and 6 one-staged (66%). 6 were treated with antibiotics and 3 without. 3 knee prostheses were temporarily replaced by a spacer (43%), 2 exchanged one-staged (29%) and 2 debrided with retention (29%). All knees received antibiosis for at least 6 weeks. In total 19 patients were administered antibiotics, leaving 7 contaminations (4 shoulders, 3 hips) without, which were analyzed regarding relapse. None of these, or the ones having received antibiotics, had later joint samples positive for P. acnes.
Conclusion: When correct intraoperative bacteriological sampling with at least 3 specimens is performed, a single positive sample of P. acnes during revision arthroplasty might not need to be treated with longtime antibiotics.

P98

Low grade pelvic chondrosarcoma treated by wide excision with custom-made osteotomy guides and reconstruction with the extracorporeally irradiated tumour as autologous osteocartilaginous graft. A case report

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Introduction: Primary tumours of the pelvis, especially around the acetabulum are difficult to treat, mainly because of the complexity of local anatomy. Custom made cutting guides have gained popularity in orthopaedic surgery, thank to their accuracy, ease of use and reproducibility. Their use, however, has rarely been described for the treatment of malignant pelvic bone tumours. We présent the case of a patient with a low grade chondrosarcoma of the iliopubic ramus and acetabulum treated with this technique.
Case report: A 30 year old pregnant patient was referred to our sarcoma centre with left hip pain after a low energy trauma. MRI and surgical biopsy revealed a chondrogenic tumour of the left iliopubic ramus, infiltrating the anterior acetabular wall, compatible with a low-grade chondrosarcoma. The patient was followed up closely by MRI and definitive treatment was postponed to after delivery. Surgery was performed 3 months after uncomplicated childbirth by C-section. Thoraco-abdominal CT did not reveal distant metastases. Wide excision was performed using a double incision with a modified Smith-Petersen approach and anterior dislocation of the hip for exposure of the iliopubic eminence and the acetabulum. The C-section incision was used to expose the medial aspect of the iliopubic ramus. CT and MRI based custom made osteotomy guides (Materialise, Leuven, Belgium) were used to perform the osteotomies through the iliopubic ramus and the anterior acetabular wall. Debulking of the tumour was performed on the back table and the specimen was irradiated with 10MV photons at a dose of 50 Gy. It was then reimplanted in its anatomical position and fixed with plates and screws and the hip was then reduced. Postoperative evolution was uneventful and the patient was discharged home ten days after surgery.
Discussion: The use of custom made guides allowed close but safe margins, and maximal sparing of joint surface. The autologous osteocartilaginous graft after extracorporeal suppressive irradiation of the specimen allowed anatomical reconstruction of the pelvis and hip, with preserved function and potentially delayed secondary degenerative changes. This technique may represent a viable alternative for the treatment of some sélecte malignant tumours of the pelvis.

P99

Simultaneous bilateral atypical femoral shaft fractures after short-term ibandronate therapy

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Introduction: Osteoporosis is the most common cause of fractures in elderly. Recommended treatments include the use of bisphosphonates (BPs), which long proved to be efficient in fracture prevention. They are also known for causing atypical fractures of the femoral shaft. We present a rare case of simultaneous bilateral atypical femur fractures after a short-term ibandronate therapy.
Case report: A 77 yo female patient under treatment of ibandronate for 2 years, presented to her general practitioner (GP) with a 2 months history of bilateral thigh pain. Radiographs and MRI of lumbar spine, pelvis and proximal femurs showed no anomaly. A corticoid based infiltration was inefficient and she started using crutches for walking. She then presented bilateral mid-shaft transverse femur fractures while standing up from a chair. Radiographs revealed lateral cortex thickening and some periosteal reaction at both fracture sites. Labor tests did not reveal vitamin, electrolytic or hormonal deficiencies. Ibandronate was discontinued and substituted with Ca++ & vitamin D. All favouring drugs were stopped. Bone mineral densitometry revealed osteoporosis (T-score of –3.2) at the level of L1–L4. She was treated by bilateral closed reduction and antegrade nailing. Both fractures healed uneventfully after 5 months.
Discussion: BPs have shown to be an efficient osteoporosis treatment, with a significant decrease in associated fractures. Atypical femoral shaft fractures are a well-known side effect, with unclear mechanism. Incidence is low after 2 years (0.3/100,000/year), but grows progressively up to 113.1/100,000/year after more than 8 years, so that treatment should be discontinued after 5 years. Our case is unusual, due to the short duration of BP treatment (2 years), the drug that was used, ibandronate being less likely to produce atypical fractures, and presentation (simultaneous, bilateral and displaced fractures). On the other hand, prodromal signs were typical: indeed, groin or thigh pain of unclear origin in a patient under BPs should raise suspicion for impending atypical fracture. Investigations should include total femur radiographs and MRI; SPECT-CT can be added if necessary. BPs should be discontinued if any doubt subsists. Close collaborations with bone disease specialists and GPs are necessary to detect, prevent and treat osteoporosis and its complications. In case of impending fracture, prophylactic bone fixation can sometimes be considered.

P100

Revision by silver coated total femur prosthesis for infected tumoral hip arthroplasty. A case report

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Introduction: Management of bone loss in revision arthroplasty is demanding, in particular for after tumor resection. When bone loss does not allow stable stem reimplantation, total femur replacement is an option. We present the case of a two stage-revision for an infected proximal femur megaprosthesis.
Case report: A 74 yo female patient was treated in our sarcoma centre by wide resection and reconstruction with a massive total hip arthroplasty for a high grade chondrosarcoma of the proximal femur. Ten months later, she was re-admitted with severe hip pain and elevated blood inflammatory markers (CRP of 155 mg/l and a WBC of 22 G/l). Hip aspiration showed methicillin sensitive S. epidermidis. A two stages revision approach was chosen and an antibiotic loaded cement spacer implanted after compete removal of the primary prosthesis. A 4 week interval was decided before reimplantation. Reconstruction with a proximal femur stem was not possible due to the small size of the distal bony segment and poor bone quality. The remaining femur was therefore completely resected and a Megasystem C Por-Ag® (LINK® implants) total femur implanted with a dual mobility cup. Antibiotherapy was maintained for a total of 3 months. Postoperative follow-up was favorable. The patient was discharged after 2 months. She was partially dependant for ADL.
Discussion: Revision of tumor megaprostheses is demanding and its incidence will increase in the future. Total femur replacement is a viable option in case of severe bone loss, with a too short residual bone stump for reimplantation of a new stem. Soft tissues management is a key point in infection prevention and should include early planing of flaps to allow proper wound closure. Silver coated implants represent a new tool to decrease (re-) infection rates but longer follow-up is needed, in particular to monitor the late systemic effects of silver.

P101

Human myogenic precursor cells are multipotent stem cells that inhibit allogeneic T cell proliferation

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Introduction: Myogenic precursor cells (MPC) are easily expanded ex vivo and are considered as a potential tool for cell-based therapies aimed at the regeneration of skeletal muscle induced by massive injury or Duchenne Muscular Dystrophy (DMD). For an efficient therapeutic effect, human MPC have to persist in the host and escape its immune response to avoid rejection. With the aim of evaluating the immunogenicity of human MPC as compared to human mesenchymal stem cells (MSC), we investigated in vitro, their capacity to differentiate into adipocytes, chondrocytes and osteoblasts, and their ability to inhibit allogeneic T cell proliferation.
Methods: All methods related to the human study were approved by the Commission Cantonale d'Ethique de la Recherche from the Geneva Cantonal Authorities. Skeletal muscle biopsies and femoral heads were collected during orthopedic surgery of patients after informed consent of the donors. Skeletal muscles were enzymatically dissociated and human MPC isolated after flow cytometry cell sorting. Confluent monolayer of MSC and MPC were incubated for 4 weeks in adipogenic, chondrogenic or osteogenic induction medium. T lymphocytes were labeled with CFSE (carboxyfluorescein succinimidyl ester) prior to co-culture with allogeneic MSC or MPC. Co-cultures were complemented with beads coated with anti-CD3 anti-CD28 mAb at initiation, to induce T cell activation. T cell proliferation was assessed by flow cytometry after 5 days of co-culture. The statistics analysis used the Student T-test with significance at a p-value ≤0.05.
Results: Flow cytometry analysis showed that human MPC and human MSC shared numerous cell surface markers including CD73, CD90, CD105 and CD146. CD56, often considered as a myogenic marker on non-leukocytic cells, was expressed by MPC only. MPC generated myotubes with fusion index of 60% after 2 days in myogenic differentiation conditions, whereas human MSC did not. Adipocytic, chondrogenic and osteogenic differentiation capacities of human MSC and of human MPC were similar. Finally, as observed for human MSC, we demonstrated that human MPC significantly inhibited the expansion of alloreactive T cells in vitro with no significant differences.
Conclusion: Immunological rejection of therapeutic cells might represent a major limitation of their use. Here we show that human have certain immunological privileges, which may decrease their risk of rejection after allotransplantation.

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Retained surgical gauze swab migration in a paraplegic patient: a case report and literature review

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Introduction: Gossypiboma is a serious but uncommon complication of surgical interventions. Most case reports and reviews refer to abdominal or thoracic surgery. Retained postoperative foreign bodies in limb or spine surgery are less commonly encountered. We present a case of gossypiboma in a paraplegic patient originating from pararectal surgery and detected 15 years after index surgery for infectious migration to the left thigh.
Methods: We present an unusual clinical case and performed a systematic literature review on the subject.
Case presentation: A 56-year-old paraplegic patient with complete sensory deficit in both legs presented with signs of an infected haematoma at the left thigh. At the time of surgical evacuation cotton tissue originating from a surgical gauze swab was retrieved. After a thorough investigation of the patient's medical history, polytrauma treatment consisting of emergent laparotomy with abdominal gauze packing in 1986 and surgical treatment of a fistulating pararectal abscess in 2001 were stated possible origins of the intraoperative findings. Further surgical interventions with a more extended approach were necessary. Another gauze tissue conglomerate was found next to the ischial tuberosity, revealing the surgical treatment of a pararectal abscess (developed from sacral decubiti) as the origin of the retained gauze swabs.
Conclusion: Retained surgical gauze (RSG) swab is a serious and, due to medicolegal reasons, underreported complication of surgical intervention. Diagnosis can be challenging because patients may present with only vague symptoms. In the presented case the patient remained asymptomatic for 15 years, mainly due to his paraplegia. Prevention of RSG is far more important than cure. Awareness of the problem, staff training and the use of preventive measures as radiopaque labelled gauze swabs or monitored counting should be mandatory in every surgical intervention.

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Co-treatment of osteoporosis in elderly fracture patients: a need without burden for our budget!

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Introduction: Osteoporosis becomes apparent from a low energy fracture. Secondary fracture prevention should then be applied. This takes place in only 20% of the affected patients. The rate can be improved with a Fracture Liaison Service (FLS): patients aged >65 who are treated for low energy fractures are only identified from the hospital. The dedicated FLS team then takes the task to organize an osteoporosis workup. The question comes up if this service is self-financed in our healthcare system.
Methods: Our FLS is a cooperation between the clinic for Orthopedic and Trauma Surgery in a public hospital and a private osteoporosis outpatient clinic. Following identification, the FLS team interview the patients in face, consult the electronic medical records and add information from the family physician. This case finding helps to exclude patients in poor general health or patients who denied to take part in an osteoporosis workup. Costs for case finding are being caused by all patients who were identified from the hospital. The reduced patient group includes patients who were found eligible for a first osteoporosis workup as well as patients who had already been subject to osteoporosis diagnostics in the past. These patients are given appointments in the osteoporosis outpatient clinic by the FLS team. This administrative effort is another cost factor. The net financial result calculates from the bills for diagnostics and therapy reduced by 63% for the running costs in the osteoporosis outpatient clinic. Patients who do not show up for an appointment create costs but do not contribute to the financial result of the FLS.
Results: Overall 1270 patients (average age: 81y, average 10y risk for osteoporotic fracture: 27%) were identified in between 01/2014 until 12/2015. 763 patients were excluded, 507 patients were eligible to take part in the osteoporosis workup. Amongst them there were only 24 "No Shows". 483 patients took part in the osteoporosis workup and therapy according to their needs. The net payback to the FLS was CHF 62.116. The net costs were 20% wage of the FLS nurse and 20% wage for the FLS coordinator, who offered consultations in the osteoporosis outpatient clinic on 127 days X 4h.
Conclusion: Depending on the wage bill of the FLS team the financial result from an FLS can be balanced. Rigorous case finding was found to be "key" in order to avoid unnecessary costs. This finding is important, because new FLS are expected to work self-financed.

The numbers refer to the pages of this supplement.