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FM 1

Thorax kinematic modelling for clinical gait analysis: a preliminary study

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Introduction: Patients with gait disorders present specific deformities and dysfunctions of the locomotor system that require specific strategies to keep their gait as efficient as possible. Clinical gait analysis, consisting to quantify accurately a person gait, has permitted to understand numerous compensatory mechanisms occurring at the lower limbs. Until now, the upper body is considered as the passenger part during walking and has not been investigated extensively. However, this is the heaviest part of the body and numerous compensatory mechanisms occur on this part. Before to study these compensations, we need to define the best way to quantify the movements of the thorax. Therefore, the objective of this preliminary study is to determine the most suitable model for calculating thorax kinematics during clinical gait analysis.

Methods: Three subjects have performed two series of movements (arm, head, trunk) with large amplitude, during standing position and walking. Reflective markers were taped on the thorax (C7, T2, T4, T6, T8, T10, T12, manubrium, sternum, clavicles) and their 3D positions were captured with a opto-electronic system (VICON Mx40 – 10 cameras). Each combination of 3 or 4 markers have been tested and compared with the literature models. The global error of each model was computed with the estimated position of the markers considering the thorax segment as a solid segment (Challis method). Angles for each model have been computed according to ISB recommendations and Baker rotation sequences. The best model is used as reference to calculate the RMS error between this model and literature models.

Results: The best model was defined by the markers T2, T10 and manubrium with a RMS error of 6.2 mm. The literature models showed an error ranging from 6.7 and 11.8 mm. These errors generated errors on the kinematics estimated between 2.2 and 17.8°.

Conclusions: This first preliminary study showed a non negligible error linked with the deformation of the thorax segment and with the skin artefacts. One should be aware that literature models of the thorax present errors that could have an influence on the interpretation on clinical gait analysis results. Based on these preliminary results, we advice to clinical gait analysis laboratories to quantify the movements of the thorax with the model defined by the markers placed on T2, T10 and sternal manubrium.

FM 2

Assessment of a new MRI classification of spinal stenosis based on cross sectional morphology of the dural sac

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Introduction: Quantitative measures of degree of lumbar spinal stenosis (LSS) such as antero-posterior diameter of the canal or dural sac cross sectional area vary widely and do not correlate with clinical symptoms or results of surgical decompression. In an effort to improve quantification of stenosis we have developed a grading system based on the morphology of the dural sac and its contents as seen on T2 axial images. The grading comprises seven categories ranging from normal to the most severe stenosis and takes into account the ratio of rootlet/CSF content.

Material and methods: Fifty T2 axial MRI images taken at disc level from twenty seven symptomatic lumbar spinal stenosis patients who underwent decompressive surgery were classified into seven categories by five observers and reclassified 2 weeks later by the same investigators. Intra- and inter-observer reliability of the classification were assessed using Cohen's and Fleiss' kappa statistics, respectively.

Results: Generally, the morphology grading system itself was well adopted by the observers. Its success in application is strongly influenced by the identification of the dural sac. The average intra-observer Cohen's kappa was 0.53 ± 0.2. The inter-observer Fleiss' kappa was 0.38 ± 0.02 in the first rating and 0.3 ± 0.03 in the second rating repeated after two weeks.

Discussion: In this attempt, the teaching of the observers was limited to an introduction to the general idea of the morphology grading system and one example MRI image per category. The identification of the dimension of the dural sac may be a difficult issue in absence of complete T1 T2 MRI image series as it was the case here. The similarity of the CSF to possibly present fat on T2 images was the main reason of mismatch in the assignment of the cases to a category. The Fleiss correlation factors of the five observers are fair and the proposed morphology grading system is promising.

FM 3

The clinical utility of a six-minute walk test in lumbar spinal stenosis

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Introduction: Patients self report of walking distance after decompressive surgery for lumbar spinal stenosis may be over- or underestimated. We conducted a prospective study to examine the clinical utility of a six-minute walk test to measure outcome after decompressive surgery in lumbar spinal stenosis patients.

Patients and methods: A total of 48 patients (mean age 76 y) with symptomatic lumbar spinal stenosis as shown on MRI and/or myelography were enrolled in the study. All patients underwent open interlaminar decompression. In 19 patients additional fusion was performed. Walking distance was measured using a standardized six-minute walk test preoperatively and at three, twelve and twenty-four months follow up. All analyzes were adjusted for walk before surgery, bmi, and type of surgery.

Results: Walking distance improved significantly from 275 m preoperatively to 400 m at 2 years follow-up. Analyzed by gender, men showed 33% more improvement than women (p = 0.0013) at final follow up. Similarly, patients younger than 75 y showed 21% more improvement than patients 75 y and older (p = 0.004).

Conclusions: The six-minute walk test demonstrated significant improvement of walking distance after decompressive surgery in lumbar spinal stenosis. It provides objective data supplementing patients' self report and improving outcome assessment in spinal stenosis.

FM 4

Outcome after lumbar spine surgery: do the patient and surgeon see eye-to-eye?

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Introduction: Patient-orientated questionnaires are becoming increasingly popular in the evaluation of surgical outcome and are considered to provide a less biased assessment of the result than traditional surgeon-based ratings. The present study quantified the level of agreement between patients' and doctors' global outcome ratings after lumbar spine surgery.

Methods: 937 German-speaking patients (60.5 ± 15.6 y; 540 F, 397 M) who had undergone lumbar spine surgery 3-months earlier rated the global outcome of the operation on a Likert scale ("operation helped a lot" through to "operation made things worse"). They also completed the Core Outcome Measures Index and rated their overall satisfaction with treatment. The surgeon completed a SSE Spine Tango Follow-up form, blind to the patient's evaluation, rating the outcome with the McNab criteria ("excellent" through to "poor").

Results: There was a significant correlation (Rho = 0.58, p < 0.0001) between the surgeons' and patients' ratings. However, their ratings matched exactly in only 51% of the cases; the surgeon gave better ratings than the patient ("overrated") in 25% cases and worse ratings ("underrated") in 24% cases. There were significant differences between the 6 surgeons in the degree to which their ratings matched those of the patients, with senior surgeons "overrating" significantly more often than junior surgeons (p < 0.001). "Overrating" was significantly more prevalent for patients with a poor self-rated outcome (measured either as global outcome, COMI score change, or satisfaction; each p < 0.001). In a multivariate model controlling for age and gender "low satisfaction" and "senior surgeon" were the most significant unique predictors of surgeon "overrating" (p < 0.0001; adjusted R² = 0.20). Comorbidity grade, first time vs. repeat surgery, and one-level vs. multilevel surgery had no unique significant influence.

Conclusion: The study highlights the potential bias in studies that rely solely on surgeon ratings of outcome and indicates the importance of collecting data from both the patient and the surgeon, in order to provide a balanced view of the outcome of spine surgery.

FM 5

Comparison of outcomes in mono segmental lumbar Total Disc Replacement regarding preoperative nucleus pulposus status, herniated/non herniated and sciatica – data analysis of 358 patients from an observational multi center study, SWISSpine

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Study type and introduction: To date, herniated nucleus pulposus (NP) with radiculopathy and central or lateral recess stenosis are considered as contraindications for lumbar disc arthroplasty. In the

present study we used data from a unique mandatory spine register, SWISSspine to investigate associations between preoperative status of NP herniated/non herniated with presence/absence of sciatica and clinical outcome. The mode was a prospective observational multicenter study

Methods, patient sample, intervention and outcome: Between 3/2005 and 8/2008, 358 monosegmental lumbar total disc arthroplasties were documented. The data collection included peri-operative data and clinical outcomes based on NASS, EuroQol and VAS. The patients were divided into 4 groups: group I-128 patients with herniated NP with sciatica, group II-48 patients with herniated NP without sciatica, group III-74 patients without herniated NP but with sciatica and group IV-108 patients without herniated NP and no sciatica (classic indication). The groups were pair wise compared regarding 1-year postoperative VAS, EuroQol and NASS scores using ANOVA-test with Bonferroni-Holm adjustment ($\alpha = 0.05$)

Results: The 4 groups had similar demographic characteristics. Statistical analyses showed no significant outcome differences between the classic and the other indications. For example a outcomes for group IV: NASS back pain pre-post: 72.0/31.7 EQ-5D pre-post: 0.32/0.69.

Discussion and conclusion: Our analysis revealed no differences between patients with herniated NP combined with neural compression and patients with stenosis of recesses regarding pain alleviation and QoL improvement. The findings suggest that these diagnoses may not have to be considered as absolute contraindications for TDR anymore. The results of this multicenter observational study however, need to be verified in a more controlled or experimental study design.

FM 6

Translaminar screw fixation of the lumbar spine: patient-oriented outcome after an average of 10 years

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Introduction: Translaminar screw fixation represents an alternative operative technique to transpedicular fixation systems for short segment lumbar fusion. The method has been in use for more than twenty years, but few studies reporting the long-term outcome are to be found in the literature. This study sought to evaluate the long-term results after translaminar screw fixation of the lumbar spine in a large group of patients and to identify predictors of a good outcome.

Methods: The Core Outcome Measures Index, a multidimensional outcome questionnaire, was sent to 646 consecutive patients who had undergone lumbar fusion with translaminar screws between 1987 and 2004, for various degenerative conditions of the lumbar spine. Patients also rated the global outcome and their satisfaction with treatment. Disc height was measured from preoperative radiographs using the distortion compensated roentgen analysis (DCRA) method. Multiple logistic regression analysis was used to identify factors associated with a good outcome.

Results: 479 patients (74%) completed and returned the questionnaire. The average follow-up period was 10 years (range 2–20 years). 354/479 patients (74%) reported that the operation had either “helped a lot” or “helped” (= good outcome); 125/479 patients (26%) declared that it “helped only little”, “didn’t help” or “made things worse” (= poor outcome). Controlling for potential confounders, a preoperative disc height <80% of that reported for a normal population was the most significant unique predictor of a good outcome (OR = 15.11, CI 95% 7.18–31.78, $P < 0.0001$).

Conclusion: Translaminar screw fixation is a straightforward and effective technique for short segment fusion in the lumbar spine. For patients with a strict indication for spondylosis, intact posterior elements (lamina and facets) and a low preoperative disc height, translaminar screw fixation represents a very successful fixation technique in the lumbar spine with good long-term results.

FM 7

Lumbar microdiscectomy compared with standard discectomy: influence on patient-orientated outcome

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Introduction: Studies comparing the relative merits of microdiscectomy and standard discectomy report conflicting results, depending on the outcome measure of interest. Most trials are small, and few have employed validated, multidimensional patient-orientated outcome measures, now considered essential in outcomes research. In the present study, the question was addressed using data collected prospectively from 6 surgeons participating in a surgical registry.

Methods: Inclusion criteria were: lumbar/lumbosacral degenerative disease; discectomy/sequestrectomy without additional fusion/

stabilisation; German or English-speaking. Before and 3 and 12 months after surgery, patients completed the Core Outcome Measures Index comprising questions on leg/buttock pain, back pain, back-related function, symptom-specific well-being, general quality-of-life, and social and work disability. At follow-up, they rated overall satisfaction, global outcome, and perceived complications.

Results: Compliance with the registry documentation was excellent: 87% for surgeons (surgery forms), 91% for patients (for 12 months follow-up). 261 patients satisfied the inclusion criteria (225 microdiscectomy, 36 standard discectomy). The standard discectomy group had significantly greater blood-loss than the microdiscectomy ($p < 0.05$). There were no group differences in the proportion of surgical complications or duration of hospital stay ($p > 0.05$). The groups did not differ in relation to any of the patient-orientated outcomes or individual outcome domains ($p > 0.05$).

Conclusion: Though not equivalent to an RCT, the study included every single eligible patient in our Spine Center and allowed surgeons to use their regular procedure; it hence had extremely high external validity (relevance/generalisability). There was no clinically relevant difference in outcome after lumbar disc excision dependent on the use of the microscope. The decision to use the microscope should rest with the surgeon.

FM 8

An observational study of multidimensional patient-rated outcome 1 year after cervical disc arthroplasty or fusion

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Introduction: Randomised controlled trials (RCTs) of cervical disc arthroplasty versus fusion generally show more favourable results for arthroplasty. The aim of this study was to examine whether the findings of RCTs are verified by observational data recorded in our Spine Center’s spine surgical registry.

Methods: All German-speaking patients in our Spine Center who (since Feb 2004) underwent either fusion/stabilisation or disc arthroplasty for degenerative cervical spinal disease were requested to complete a questionnaire at baseline and at 12 months post-op. The questionnaire comprised the multidimensional Core Outcome Measures Index (COMI) and, at follow-up, additional questions on global outcome and satisfaction with treatment (5-point scales). The surgeon completed a Spine Tango Surgery form.

Results: The data from 217 patients (174 fusion, 43 arthroplasty) were available (follow-up rate, 92%). Patients with cervical disc arthroplasty were significantly younger (46.1 (SD 7.2) versus 56.0 (SD 10.7) for fusion; $p < 0.05$); more of them had only monosegmental pathology (66% arthroplasty, 46% fusion), and only one type of degenerative pathology (71% arthroplasty, 44% fusion). Co-morbidity was significantly lower in arthroplasty patients (ASA 1, 69%; ASA2, 30%; ASA 3, 1%) than in the fusion patients (ASA 1, 29%; ASA2, 59%; ASA 3, 12%). Operation duration was significantly shorter in the arthroplasty group ($p < 0.05$). Surgical complication rates were similar in each group (arthroplasty, 1.5%; fusion, 2.6%). The reduction in the COMI score was significantly greater in the arthroplasty group (5.2 (SD 2.7) vs 3.7 (SD 2.8) points $p < 0.05$). A “good” global outcome was recorded in 93% patients in the arthroplasty group and 79% in the fusion group ($p = 0.04$). Satisfaction with treatment was similar in both groups (arthroplasty 93%; fusion 90%; n.s.). Multiple regression analysis revealed that treatment group was a significant predictor of the change in COMI (arthroplasty better than fusion; $p = 0.02$), even after controlling for other confounders (age, comorbidity, etc.).

Conclusion: The results of this observational study appear to support those of the RCTs and suggest that disc arthroplasty is associated with significantly better results in degenerative pathology of the cervical spine.

FM 9

The effect of post-surgical rehabilitation on outcome after surgical decompression of the lumbar spine: a randomized controlled trial with 5-year follow-up

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Introduction: As the population ages, surgical decompression of the spine is being performed with increasing frequency and now constitutes the most common type of spinal surgery in the older patient. Physiotherapy is often prescribed after such surgery, although its long-term benefits compared with no formal rehabilitation have yet to be demonstrated. This randomised controlled trial examined the effects on outcome 5 years after surgery of supervised postoperative physiotherapy compared with no formal therapy.

Methods: 159 patients (100 men, 59 women; 65 ± 11 years) undergoing decompression surgery for degenerative disorders (spinal stenosis/herniated disc) were randomised to one of the following

programmes, beginning 2 months post-op: self-management, recommendation to "keep active" (CONTROL; n = 54); physiotherapy focusing on spine stabilisation exercises (PT-StabEx; n = 56); standard physiotherapy using mixed techniques (PT-Mixed; n = 49). Both PT programmes involved 2x30 min sessions/week for 12 weeks, with home exercises. Pain intensity (0–10 graphic rating scale, for back and leg pain separately) and self-rated disability (Roland Morris) were assessed before surgery and at various stages up to 5 years later. 'Intention to treat' analyses were used.

Results: 10 patients had died before the 5-y follow-up. Of the remaining 149 patients, 143 returned a 5 y follow-up (FU) questionnaire (effective return rate excluding deaths, 96%). There was a slight but non-significant increase in leg pain from 2 months post-op to 5 years later, with no significant differences between the

rehabilitation groups. Low back pain showed a small but significant ($p < 0.05$) increase from 2 months post-op to 5y later, again with no group differences. In the whole patient group, disability decreased significantly from 2 mo post-op to 5y later: the CONTROL group showed no significant difference in the extent of the reduction compared with each of the two PT groups ($p > 0.05$); the PT-StabEx group showed a significantly greater reduction than the PT-Mixed group ($p < 0.05$).

Conclusion: Advising patients to keep active by carrying out the type of physical activities that they most enjoy appears to elicit comparable long-term results to formal physiotherapy but at no cost to the health-care provider.

Free communications II

FM 10

Increase in risk of subtrochanteric insufficiency fractures in patients using bisphosphonates

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Introduction: Over the last 10 years we have seen the emergence of a new type of subtrochanteric insufficiency fracture occurring with little or no trauma in patients older than 50 years of age. X-rays show a localized abnormal thickening of the outer cortex of the femoral shaft. The etiology of this new type of fracture remains unknown. It has been suggested that bisphosphonates, used in primary prevention of osteoporotic fractures among postmenopausal women since 1995 (date of FDA approval), are involved. Our objective was to identify patients with this specific type of insufficiency fracture and determine a possible relationship between fracture and a prolonged course of bisphosphonates treatment

Method: All X-rays for patients admitted to our institution since 1999 following a subtrochanteric fracture were examined. Patients presenting a typical radiologic pattern involving a transverse fracture line originating through a cortical thickening at the lateral femoral cortex were identified. We then determined whether these patients had received treatment with bisphosphonates in the years preceding the fracture.

Results: Between 1999 and 2008 there were 258 patients admitted with a diagnosis of "sub-trochanteric fracture" according to the International Classification of Diseases (ICD - 10). Among these patients, we identified 19 cases (95% women with a median age of 75 years; 31% bilateral fractures) whose clinical and radiological presentation corresponded to a low-energy insufficiency fracture. Radiological criteria included a transverse fracture of the proximal shaft or subtrochanteric region with abnormal cortical thickening. Sixteen patients had been treated with long-term bisphosphonate therapy. The mean number of years these patients had been treated is 4.12 years. We have also seen an increasing number of subtrochanteric insufficiency fractures compared to the total number of sub-trochanteric fracture (fig. 1).

Conclusion: A new type of subtrochanteric stress fracture has recently appeared. This same observation has been reported in several recent publications, and long-term bisphosphonate therapy appears to be a regular associated finding in these cases. Based upon this disturbing observation, we believe that bisphosphonates should be considered as a probable cause of these stress fractures until proven otherwise.

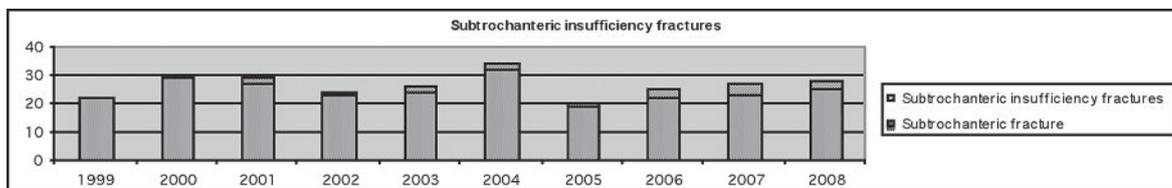


Figure 1 Subtrochanteric insufficiency fractures compared to the total number of sub-trochanteric fracture.

FM 11

Influence of patient activity level on stem osteolysis 5–10 years after total hip arthroplasty

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Introduction: Following total hip arthroplasty (THA) patient interest in returning to athletic activity may compromise implant survival. The orthopaedic literature on sports activity and implant survival is limited to small retrospective studies with short-term follow-up. Our objective was to evaluate the influence of patient activity level on stem osteolysis 5–10 years after THA.

Methods: We conducted a prospective cohort study of patients with hybrid THAs (uncemented cup, cemented stem, 28mm head and ceramic-polyethylene bearing surface). All patients were evaluated clinically and radiologically at either the routine 5 or 10-year follow-up visit. Activity was measured using the University of California, Los Angeles (UCLA) activity scale and evaluated as continuous and categorical variables. We defined low = 1–4, average = 5–7 and high activity = 8–10 points. Detailed information regarding the specific type and number of sports activities was additionally obtained. Main outcome was the radiological assessment of osteolysis.

Results: 486 THAs (280 women, 206 men) were included. Mean age at the time of operation was 67.7 years. 49% of the patients were seen at 5 and 51% at 10 years post-operative. 20.3% reported one or more sports activities, mostly bicycling, swimming, gym and less often skiing, mountain hiking or golf. Osteolytic lesions were identified in 9 of 163 patients with low activity (5.5%), in 20 of 268 with average (7.5%), and in 13 of 55 with high activity (23.6%). Regular participation in average activities (7 points) such as bicycling led to osteolysis in 5 of 52 patients (9.6%). Osteolysis risk increased with a greater number of different sports performed. Among normal weight patients, osteolysis was present in 37.9% of those with high activity compared to 7.7% among overweight/obese with high activity ($p = 0.009$). In multivariate logistic regression adjusting for BMI, age, sex and time to follow-up, the adjusted odds ratio for developing osteolysis comparing high vs. average activity was 3.1 (95% CI 1.3; 7.3).

Conclusion: A high activity level was associated with a substantially greater risk of osteolysis 5–10 years after THA, especially in normal weight patients in contrast to overweight patients with similar UCLA scores. This could be related to differences in frequency and intensity within a given activity level.

FM 12

Comparison of acetabular cup position in total hip arthroplasty between ultrasound-based navigation and postoperative 3-D computer tomography

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Introduction: Malpositioning is a common surgical problem in total hip arthroplasty. Computer assisted orthopaedic surgery (CAOS) technology has recently been introduced to overcome this problem. The majority of hip navigation systems use the anterior pelvic plane as part of the reference system. With image-free systems, anatomic pelvic landmarks must be acquired intraoperatively in order to define the anterior pelvic plane. This step could potentially introduce deviation for navigation, especially in obese patients. The use of ultrasound based navigation systems tries to overcome this problem. The current study shows an analysis of accuracy of the ultrasound based navigation of cup positioning during surgery compared to postoperative CT-scans. **Methods:** 16 total hip arthroplasties were implanted by using ultrasound based navigation system. The positions of the implants were determined three-dimensionally 7 days postoperatively using computed tomographic measurement. This analysis can avoid failure of pelvic tilt in radiographs. The CT measurements used the same reference system as the navigation system. The difference between the intraoperative cup orientation, as displayed by the navigation system and the postoperative cup position, measured on computer tomography data, were evaluated.

Results: The average difference between intraoperative navigation and postoperative CT measurements were found to be 2.8° (SD ± 1.8°) for inclination and 2.2 (SD ± 1.6°) for anteversion.

Conclusion: These data show that using an ultrasound-based navigation system is an accurate tool to reduce variability and range of cup position well. We found only little differences between navigation system data and postoperative CT measurements. Therefore we recommend ultrasound based navigation as a very exact tool for cup positioning in THA.

FM 13

Exertion, rest and night pain assessment – how predictive of outcome after total hip replacement?

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Introduction: The assessment of pain in the categories exertion, rest, and night pain is established and widely used. Analysis of more than 1200 patient data sets has shown that three major clusters can be differentiated: (A) predominantly exertion pain, (B) chronic pain and (C) predominantly night or rest pain. Does this distribution have any relevance in clinical practice? Is there any difference in outcome after total hip replacement between these three groups?

Patients and methods: Included were coxarthrosis patients who had been fitted with a total hip prosthesis at a university clinic. Excluded were patients with fracture, infection, tumor/metastasis, or major postoperative complications. The patients completed questionnaires (Painnaire, current version) one week before and 6 weeks after surgery. They were allocated to one of the 3 pain groups (A, B, or C) and the outcome (reduction in pain scores) calculated.

Results: Included were 84 patients (52% women) treated in 2006. Median age was 61 years, BMI was 27.4 kg/m². Total pain score was reduced significantly from preoperative mean 45.98 to postoperative 13.5 (p < 0.05). Mean pain score changed in group A from 46.7 to 13.0, in group B from 41.7 to 16.7, in group C from 47.3 to 13.7. Percentage post-operative reduction in pain score was 71% in group A, 61% in group B, and 72% in group C.

Discussion: The differences in outcome after total hip prosthesis between the pain groups was surprisingly small; on average, pain scores in all three groups were reduced by about two thirds.

Conclusion: Pain reduction after total hip prosthesis was comparable in the three pain groups (A, B, C). Pain scores were reduced by about two thirds in all three groups.

FM 14

Periprosthetic stress femoral neck fracture after resurfacing total hip arthroplasty: a report of 3 cases

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Acute femoral neck fractures after resurfacing total hip arthroplasties have been reported in the literature. Only few papers considered non operative treatment for periprosthetic fracture after Birmingham hip procedure. Of 134 consecutive hip resurfacing procedures between

April 2002 and December 2007 we report three cases of non displaced femoral neck fractures. All three were men suffering from osteoarthritis. The first 62 yo patient developed pain progressively 4 months after the hip resurfacing without any trauma. He was totally pain free one month following the procedure. Standard Xrays were unremarkable. Scintigraphic exam showed hyperactivity around the neck and blood tests showed a slight elevated CRP. At the revision performed at 6 months we observed a fracture just beneath the head of the prosthesis. The morphological analysis confirmed a stress fracture. The second case occurred in a 43 yo active man. He reported persistent hip pain during the first 4 months. At the 6 month check the standard Xrays showed a dense horizontal line 3 millimeters distal to the femoral head component. Retrospectively, we consider that line as the result of a healed stress fracture of the femoral neck considering the history of the patient. He is now pain free. The third case occurred in an extremely active 55 yo man who did not respect our postoperative reeducation procedures. Two weeks after the operation, he tried to run without crutches. Since that time and for 6 months he sustained hip pain that disappeared rapidly after the seventh month. We did not observe any fracture or component loosening on the Xrays taken at the 1st, 2nd or 4th month. At six months, we discovered a dense line on X ray at the same position as for the preceding case. We consider once again a femoral neck stress fracture.

Conclusion: Even if femoral neck stress fracture is a rare complication after total hip resurfacing procedure, it should be considered for diagnosis and can be treated conservatively.

FM 15

A reduced femoral head neck offset increases the risk for hip osteoarthritis by factor 4. A retrospective case control study with 25 years follow-up

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Introduction: From a biomechanical point of view, the pathogenesis of hip osteoarthritis (OA) due to cam type femoroacetabular impingement is well understood and treatment options for symptomatic patients well established. However, from an epidemiological point of view, evidence that a reduced femoral head neck offset increases the risk of OA has yet not been demonstrated. The aim of this retrospective investigation was to test the hypothesis that a reduced femoral head neck offset on a Dunn-Müller-Rippstein view (Dunn views) would increase the risk to suffer from OA within the following 25 years.

Methods: Since the mid twenties patient's charts and x-rays of our department were archived and later outsourced into the archive of the state department. This allowed us to review all Dunn views acquired between 1968 and 1978. From 419 qualitatively suitable views, 228 were acquired after closure of the hip bone growth plates and could be linked to a patient, to whom an invitation to participate the present study and a questionnaire could be sent. After exclusion of patients affected by factors known to increase the risk of OA (systemic disorders, congenital and acquired hip disorders, trauma etc.) and those not willing to participate 58 patients (116 hips) gave informed consent and were assessed by standardised interview, clinical examination and anteroposterior pelvic x-ray at least 25 years after the index Dunn view. The alpha angle was used to quantify the head neck offset. Tönnis' OA grading was used to quantify osteoarthritis at follow up. Multiple regression analysis was performed to elucidate the role of the alpha angle as a risk factor for OA a minimum of 25 years later.

Results: An alpha angle >50° on the Dunn view increased the risk for OA Tönnis grade 1 or more at follow up by factor 4 (Odds. 4.03, 95% CI: 1.76 – 9.22). According to the Harris Hip Score, an alpha angle >50 was associated with significantly more pain (p = 0.02) and less function (p = 0.002) at follow up.

Conclusion: From an epidemiological point of view the present investigation provides evidence that a reduced femoral head neck offset increases the risk for hip OA.

FM 16

Long-term wear in cemented Total Hip Arthroplasty – Effect of position, orientation and armament screws on wear and loosening

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Introduction: The biological activity of PE-particles released by linear wear is an important factor in aseptic loosening of Total Hip Arthroplasty (THA). In a prospective patient population, risk factors for PE wear and their influence on osteolysis and aseptic loosening were analysed.

Methods: Between 1984 and 1987 a total of 101 THA with the Müller straight stem with a 32 mm head combined with a cemented Müller

all-poly cup (with or without armament screws) have been implanted. All implants had a standardised clinical and radiological follow-up. The pre- and postoperative centre of rotation was compared and the inclination and anteversion of the cup determined. Migration of the cup according to Nunn and linear wear as described by Livermore were measured. The whole radiological series were analysed for progressive osteolysis using the zones of DeLee and Charnley on the cup site and the Gruen zones on the stem site. Reasons for revisions during follow-up were additionally checked.

Results: Of the 101 hips 4 were lost and 5 had an incomplete radiological follow-up. Of the remaining 92 hips 53 were in male patients. The average age at operation was 65.7 (± 9.1) years with an average follow-up of 13.1 (± 5.1) years. 9 complete THA revisions and 13 isolated cup revisions have been performed due to aseptic loosening. Another 7 cups were radiological loose on the final follow-up without being revised. Osteolysis was found in 41 cups and 39 stems. The average linear wear was 1.2 (± 0.8) mm, the wear-rate was 0.10 (± 0.64) mm. Younger patients had increased wear ($p < 0.001$). We found no correlation of the cup position and the wear parameters but cups with higher anteversion showed more wear ($p = 0.021$). Osteolysis ($p = 0.003$) and revision ($p = 0.003$) of the cup were correlated with wear. Cups with armament screws had higher wear-rates ($p = 0.043$) and more revisions ($p = 0.022$).

Conclusion: Wear was a risk factor for cup loosening but did not affect the stem. Armament screws might cause eccentric micromotion and increase the wear-rates. A reduction of PE-wear might have reduced the revision rates. Extreme cup position and inclination seems to be better tolerated than extreme anteversion.

FM 17

Hip abductor avulsion following the transgluteal approach for hip replacement: results after conservative treatment

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Introduction: Hip abductor avulsion following the transgluteal approach for hip replacement is a difficult management problem about which little has been published. Surgical repair can improve limp and satisfaction and reduce pain, especially with early repair [1, 2], but the reported results are not uniformly good [1–5]. The goal of the study was to evaluate the outcome of patients treated non-operatively.

Methods: We retrospectively evaluated 9 patients (3 men, 6 women) treated non-operatively for symptomatic abductor avulsion following the transgluteal approach. Diagnosis was made by the presence of a limp, a positive Trendelenburg test, abductor weakness in the lateral position, and pain over the anterior greater trochanter. In 2 patients, an arthro-CT confirmed the avulsion. All patients were evaluated at a routine 5 year postoperative visit. The following parameters were assessed: pain, limp, overall function with the Harris hip score (HHS), abductor strength (isometric manual muscle testing, grade M1-M5), and patient satisfaction (visual analog scale 1–10).

Results: Patient's mean age at THA was 67 years (± 8.6). Three patients gave a history of a traumatic event including 2 dislocations and 1 fall. The mean total HHS was 74.5 points (± 10.6), with pain at 34.7 (± 8.6), and limp at 6.1 (± 3.1) points. In 4 patients abductor strength was evaluated at M3, in 4 others at M2, and in 1 patient at M1. Mean patient satisfaction was 6.2 (± 2.3), with 2 patients satisfied, 2 partly satisfied, and 5 patients dissatisfied.

Conclusions: Compared to the overall results 5 years after primary THA, our patients treated non-operatively for abductor avulsion had a less favourable outcome with only a moderate HHS and a moderate to low satisfaction. Our results did not differ much from those obtained in patients after surgical repair [1, 2], however prior to surgery those patients had a significantly poorer HHS with more pain and limping as compared to our patients. Conservative treatment might be an alternative for abductor avulsion when pain and limping are not a major disability.

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FM 18

Abductor muscle changes following lateral transgluteal hip approach

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Introduction: The lateral transgluteal approach for total hip arthroplasty may lead to persistent limping due to fatty atrophy or rupture of gluteal muscle tendons. The aim of this paper is to investigate whether a correlation between clinical examination and low-field magnetic resonance imaging (MRI) exists following a one year period after total hip arthroplasty.

Method: The prospective cohort study targets all patients examined at our clinic following a one-year period of total hip arthroplasty in case of a coxarthrosis, femur head necrosis or fracture (44 patients in two similar groups). Patients were clinically examined with regard to abductor function and symptomatic changes (pain, tenderness). The group with full abductor function was compared with patients that show insufficient abductor function and/or symptomatic changes. Using a standardized protocol for low-field MRI (0,2 Tesla), the radiologist evaluated the results blinded due to the clinical findings in accordance with the criteria: fatty atrophy, rupture, fluid collection. The study was approved by the cantonal ethics committee. Inclusion criteria: informed consent, adults. Exclusion criteria: denied consent, electronic implant (e.g. pace maker), termination by patient, other diagnosis than coxarthrosis, head necrosis or fracture; pregnancy at time of MRI examination, infection, dislocation of trochanter. Statistical analysis.

Results: 3/22 patients without limping, pain or abductor insufficiency indicated signal changes of the gluteus medius/minimus muscles ($p < 0.05$). Within the alternate group of insufficient abductors/symptomatic patients, 17/22 changes in the tendons were detected.

Discussion: Clinical examination of abductor function is important during follow-up. This study shows significant correlation of clinical abductor examination and MRI findings in abductor function. MRI has to be confirmed in symptomatic patients to evaluate the defect size in order to assess a possible reconstruction.

FM 19

Closed suction drainage with autologous retransfusion of filtered shed blood does not offer advantages in primary non cemented minimally invasive total hip replacement. A prospective randomized trial

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Introduction: To omit closed suction drainage (CSD) in primary conventional hybrid total hip arthroplasty (THA) resulted in simplified and more rapid wound management without any disadvantage in a previous investigation. This conclusion may not be transposed to minimally invasive approaches and non-cemented THA. Furthermore, the combination of CSD with retransfusion of filtered shed blood has been claimed to offer advantages in terms of blood management by others. The aim of the present investigation was to test the hypothesis that in terms of blood loss, wound management, hospital stay and short term outcome, omission of CSD would not result in any disadvantages when compared to the use of a CSD or an autologous retransfusion system (Bellovac) in primary non-cemented MIS THA using the direct anterior approach.

Methods: Power analysis resulted in 120 patients to be enrolled. Patients scheduled for primary MIS-THR were prospectively block randomized to three groups: 1) no CSD, 2) CSD and 3) Bellovac. Haematoma formation (thigh circumference, sonography), haemoglobin levels (day 0–3), blood transfusions, pain (VAS), length of hospital stay and infection rate were prospectively recorded. For statistical analysis one-way ANOVA and Kruskal-Wallis tests were used.

Results: We identified no differences between the 3 groups in terms of haematoma formation (ANOVA, $p = 0.290$), haemoglobin levels (ANOVA, $p = 0.635$) and VAS pain levels (Kruskal-Wallis, $p = 0.31$). Only in 3 patients of group 3 shed blood could be retransfused. Not using any suction drainage resulted in a shorter hospital stay (median length: 5 vs. 7 days, ANOVA, $p = 0.001$). No infections were observed so far.

Conclusion: Conclusions from a prior investigation in conventional hybrid THA can be transposed to non cemented MIS THA. Advantages from using autologous retransfusion systems could not be verified in our collective.

FM 20

Trabecular metal augments in revision total knee arthroplasty

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Major bone loss is a severe problem in the domain of revision TKA. Various surgical techniques have not been able to provide a satisfying long-term solution to this challenge. Porous Tantalum, currently marketed under the trademark «Trabecular Metal» (TM) (Zimmer; Warsaw, IN), is a new device for the compensation of segmental bone defects. We retrospectively reviewed 26 patients (27 knees) with 38 implanted TM Augments at a mean follow up time of 17 months. The results are very promising so far.

FM 21

EMG analysis of the M. vastus medialis and M. vastus lateralis with patients with patellar dislocation using the Wavelet transformation

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Introduction: In patellar dislocation a muscular cause has been discussed by many authors. It hasn't been proved yet with previous methods. The goal of this study was with the aid of the Wavelet transformation of EMG data to examine this question again.

Material and method: 16 patients, among them nine women and seven men, took part in the study with statuses after Patellarluxation. A healthy normal collective consisted of 20 men and 20 women. Only patients were examined whose luxations were of a traumatic nature and did not show any impairment of the walking patterns at that present time of injury. Electromyographic records were kept during physical tests. The raw data was processed by means of the Wavelet transformation and the frequency spectrums. Fast and slow muscle fibres were separated from each other and compared and interpreted with those of the normal collective. The EMGs were analysed regarding the intensities and abnormalities of contractions.

Results: Female patients showed an accumulated appearance of abnormalities of contractions in the M. vastus lateralis particularly triggered by fast muscle fibres.

Discussion: One can infer from the imposed data that with female patients posttraumatic instability is muscularly not equally compensated as in the case of the men. As a result of this it comes to reflective contractions which are seen in the EMG as abnormalities of contractions.

FM 22

Case report: Compression of the sciatic nerve caused by a tear in the hamstring muscles

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There are multiple causes of a post-stress injury of the sciatic nerve. It could be associated to: acetabular fractures, hip fractures and dislocations, diaphyseal fractures of femur, failure of acetabular reconstruction rings in revision hip arthroplasty, cerclage wiring of the great trochanter during a THA procedure and heterotopic ossifications. The peripheral sciatic nerve injury caused by a tear of the hamstring muscles is a less known common cause with only a few reference sources in the literature. We report a case of a 28 years old patient who is suffering of the posterior thigh pain with paraesthesia irradiating to the whole lower extremity reproducible after a 100 m run strain. The pain disappears within 30 min after the stress. The medical exam shows trough of the hamstring muscles 4 cm distal the gluteal fold. There is no pain elicited during palpation and the Tinel's sign is negative. The results of EMG and MRI studies of the sciatic nerve and the hamstring muscles were considered as normal. The medical history and clinical examination tend to confirm a post-stress injury of the sciatic nerve. During the neurolysis via posterior approach we could observe a compression of the nerve caused by a fibrous strap of 4 cm long in the depth of the m.biceps femoris. During the early and late (2 months) postoperative period we didn't notice any complications (including a neurovascular disorders), not even after a physical effort.

FM 23

Influence of component malpositioning on in vivo kinematics in mobile bearing TKA

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Introduction: Tibial and femoral component mal-alignment in TKA may cause pain, instability and possibly even lead to revision surgery. The influence of rotational mal-alignment on tibio-femoral kinematics in vivo, however, is still unknown. The aim of this study was to determine the effect of rotational mal-alignment on tibio-femoral kinematics during in vivo weight-bearing activities using fluoroscopic analysis.

Methods: In vivo kinematics were determined for 20 patients implanted with a PFC Sigma (10 posterior stabilized and 10 cruciate retaining) rotating platform knee (DePuy, Warsaw, IN). Each patient, while under fluoroscopic surveillance, performed repetitions of a weight-bearing deep knee bend. A 3D-2D model fitting technique was used to reconstruct the in vivo 3D kinematics (Medis Specials, Leiden). The 3D surgical positioning of the implant was additionally determined from CT scan data of each subject's knee. The relationship between the tibial and femoral component orientation, and the relative tibio-femoral rotation during dynamic activities was examined.

Results: The rotational deviation from the referenced axis of the femoral component show a mean of 1.4° with a SD ± 2.6° (Range between 5.4° internal rotation and 4.9° external rotation). Tibial components showed a mean of 16.3° with a SD ± 6.6° (Range between 28° and 4° internal rotation). There was no significant relationship between tibio-femoral rotation under deep knee bend and either the tibial (p = 0.791) or the femoral component position (p = 0.256).

Conclusion: No relationship has been observed in this study between the considerable tibial or the moderate femoral mal-alignment on tibio-femoral rotation under weight bearing activities. Whilst this study has not considered the possible influences of changes to the internal loading conditions, the use of mobile bearing knee arthroplasties seems to provide a kinematic compensatory mechanism for surgical mistakes.

FM 24

Prospective results of patients after complete open single-stage reconstruction of traumatic knee dislocations

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Background: The purpose of the study was to describe our treatment regimen and analyze the outcome of patients treated operatively for traumatic knee dislocations. In the former years clinical and radiological results of a large retrospective series has been described by our group.

Methods: Prospective clinical case series of all patients treated operatively for traumatic knee dislocation (reconstruction/refixation of the anterior and posterior cruciate ligament and all peripheral structures). 9 patients were evaluated with a median follow-up time of 13 months (IKDC score, SF36, the Lysholm and Knee Society Score, Tegner Activity Index, VAS pain and satisfaction).

Results: 7 of 9 patients returned to their previous work without impairment and achieved an identical sport activity level than before injury. The median VAS pain and satisfaction and SF36 score improved significantly (p < 0.01). The median side-to-side difference of the anterior laxity (KT1000, 134N) was 7 (5-14) after injury and 1 (-2-3) at follow-up. The mean posterior drawer (rolimeter in 70° flexion) was at follow-up <3 mm in 7 and 3-5 mm in 2 patients. In all patients valgus stress testing was <3 mm and varus stress testing was <3 mm in 8 and 3-5 mm in 1 patient. The IKDC score was preoperatively C in 1 and D in 8 patients. At follow-up 2 patients were in group A, 3 in B, 3 in C and 1 in D. The median Lysholm and KSS score improved significantly (p < 0.01) from 24% (5%-37%) to 98% (45%-100%) and from 79 (29-115) to 195 (108-200). The median preoperative Tegner index was 6 (3-9) and at follow-up 5 (1-9). One patient had a limited knee flexion (<70°) 6 months after initial surgery and was reoperated with arthroscopic arthrolysis. The patient regained flexion to 95°.

Conclusion: Knee dislocations remain a major therapeutic challenge, but with early complete bicruciate reconstruction and restoration of the peripheral anatomy good patient satisfaction with overall maintained sport and working activity and good functional results can be achieved. With the growth of the sample size in following years determination of prognostic factors will be possible.

FM 25

Influence of testing position on isokinetic hamstring and quadriceps performance among elite skiers

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Introduction: During isokinetic measurements, mode of contraction and testing position are of great importance.

Purpose: – two different testing positions (upright sitting and semi-reclined sitting) modify the torques for quadriceps (Q) and hamstrings (HS), – type of sport also affect the HS/Q ratios

Methods: 10 adult international level skiers (age: 18–30 yrs), 20 young national level skiers (13–17 yrs), 15 young multisports athletes (13–17 yrs) and 15 adult active athletes (control group: 18–40 yrs) were enrolled. They were tested on an isokinetic device concentrically and eccentrically. Every test included the 2 described sitting positions.

Results: – A significant difference for all groups between conventional concentric ratio and functional ecc/conc ratio. – No difference for the functional ratio between adult professional skiers and young national skiers, in both testing positions. – By comparing young skiers with young multisports athletes and adult skiers with controls, the functional ratio decreases significantly, when measured in the semi-reclined position.

Conclusions: – The functional ratio (HSecc/Qconc) is of great interest. – The hamstring eccentric torque is reduced in semi-reclined position, predominantly by skiers. – Some significant differences are seen between skiers and symmetrical sports athletes, but not between professional adult and young high level skiers.

FM 26

Amount of anterior tibial translation in relation to size and tension of flexion gap with and without posterior cruciate ligament in total knee replacement

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Introduction: With increasing flexion gap the tibia tends to translate anteriorly because of the rising tension in the PCL and posterior capsule both oriented obliquely. The hypothesis was to show that this translation is more pronounced with intact PCL than after sacrificing it.

Methods: In 90 knees operated for total knee replacement with a PS prosthesis the flexion gap was created by meticulous bony orientation and the use of a double spring tensioner without sacrificing the PCL. 78 knees were accessed by a mini midvastus approach, in 12 knees a lateral approach was necessary in case because of fixed valgus arthritis. By a custom-made tensioner the flexion gap and anterior tibial translation could be measured in mm with 100, 150 and 200 Newton applied respectively. After cutting the PCL the measurements were repeated in the same way.

Results: In the group with the intact PCL with the three distraction forces of 100, 150 and 200 Newton the flexion gap increased from in average 6.9 mm, to 7.9 mm and 9.2 mm. In the same way the anterior tibial translation increased from 0,7 mm, 1.3 mm and 1.7 mm respectively. After cutting the PCL flexion gap were in mean 7.3 mm, 8.7 mm and 10 mm, the tibial translation 0.6 mm, 1.2 mm and 1.8 mm respectively. So, after cutting the PCL the flexion gap increased 0.4 mm with 100 Newton, 0.8 mm with 150 and 0.8 mm in 200 Newton respectively. The tibial translation was not influenced significantly by cutting the PCL.

Conclusion: Balancing of the PCL in TKR remains a difficult task and is still a strong argument to sacrifice the ligament and use a posterior stabilized prosthesis. As expected the flexion gap and the tibial translation increase with rising distraction force, with and without PCL. The tibial translation is only slightly bigger with intact than with cut PCL. In addition measurements show a great variability. Obviously the behavior is changing when less invasive approaches without dislocation and eversion of the patella are used and the posterior capsule is not disrupted by an anterior dislocation of the knee. It seems that not only an intact PCL can lead to a progressive anterior drawer with increasing distraction force in the flexion gap but also an intact posterior capsule. Both will lead to a more posterior femoral contact point in CR TKR in case of too tight flexion gap.

FM 28

Short term results with 101 consecutive journey total knee replacements

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Introduction: Since December 2006 the author implanted 101 Journey total knees. Theoretical expectations included better biomechanics and therefore deeper flexion without instability.

Methods: Since 1st of December 2006 till December 2008 101 consecutive TKR Journey Knees (Smith&Nephew®) were implanted by a single surgeon in 73 women and in 28 men. The mean age at surgery was 68.9 years (46.5–84.6). In 88 knees with neutral or varus alignment a mini midvastus approach, in 12 cases a lateral approach (8 including an osteotomy of the tibial tuberosity) was necessary. The alignment was reached with the standard instrumentation and the use of a tensioner for ligament balancing. All knees were examined 2, 4 and 12 months after surgery by the authors. All the TKR were documented at the Swiss Register SIRIS.

Results: The mean flexion is 120° (80–140°) 2 months after surgery with one outlier with 45° because of arthrofibrosis. It improves to a mean of 126° (115°–145°) at 4 months and reaches 130° (85°–145°) after one year. All knees reached full extension after 4 months. 74% of the patients could kneel, 38 % were able to squat. In 3 knees a slight midflexion instability (<6°) was recorded. 7 (7%) had to be revised because of mechanical problems, one (1%) because of infection due to erysipelas. There was no thrombosis, no vascular or nerve injury.

Conclusion: The Journey Knee allows excellent mobility with a mean flexion of 116° after 2 months and 130° at one year. Patients were very satisfied in 80% of the cases.

The surgical technique is demanding as the knee seems to be less forgiving than a standard prosthesis.

FM 29

Trends in revision total knee arthroplasty 1998–2008: Patient characteristics and indications

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Introduction: The number of primary and revision total knee arthroplasties (TKA) has increased substantially over the past ten years, and major advances in implant components and techniques have been achieved. Moreover, patients presenting for joint replacement today live longer, tend to be heavier, and also more active. The objective of this study was to examine trends in patient characteristics and revision indications in patients undergoing revision TKA between 1998 and 2008.

Methods: Between March 1998 and December 2008 we conducted a prospective cohort study of all revision TKAs performed at a University hospital. We investigated trends in sex and age distribution, body mass index (BMI), indication for revision, and time between primary and revision TKA, comparing the first period 1998–2002 to the second period 2003–2008.

Results: 130 revision TKAs were included, 44 performed in the first and 86 in the second period. The annual number of revisions increased proportionally with the number of primary TKAs, resulting in a stable revision burden (5–6%). In the second period, patients presented with a higher mean BMI (27.6 vs. 29.8, $p = 0.04$), which was mainly due to an increase in the BMI category ≥ 35 kg/m². We did not find any major changes in age and sex distribution. There was a significant increase in revision for infection from 9.1% to 24.4% (RR 2.7, 95% CI 1.2; 6.2), and in peri-prosthetic fracture (0% vs. 5.8%). The proportion of TKAs revised for aseptic loosening (61% vs. 50%) changed only slightly, but the time between primary TKA and revision for aseptic loosening was significantly longer (72 vs. 111 months, $p = 0.002$).

Conclusion: We observed an increase in the annual number of revision TKAs together with a stable revision burden. Most important, there was more than a 2-fold increase in revision for infection between the two time periods. Additionally, the time between primary TKA and revision for aseptic loosening increased, however the reasons for this necessitate further investigation.

FM 30

Clinical and radiological results 20 years after lateral meniscectomy in stable knees

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Knee osteoarthritis resulting from meniscectomy is a common concern, but current literature comprising long-term follow-up of patients is scarce. Our study aims to evaluate the long-term effects of lateral meniscectomy and to identify those patients who are the most at risk of developing osteoarthritis. In a retrospective study, we reviewed 89 patients 22 years (+/3 years) after arthroscopic external meniscectomy. We analyzed their profiles (age, sex, BMI, physical activity, morphotypes, prior existence of osteoarthritis), the types of

incurred meniscal lesions, the extent of meniscal resections and the cartilage lesions initially described in the surgical protocols. After follow-up, we conducted interrogation using IKDC and KOOS subjective scores, clinical examination and radiological assessment. The mean age at the time of surgery was 35 ± 13 ; no trauma was reported in 43% of the cases. In 79% of the cases the mid-section of the lateral meniscus was torn. Two-thirds of the meniscus had to be removed in 49% of the cases. After 22 years, 44% of patients presented with osteoarthritis of the operated knee with a normal contralateral knee. Predicting factors for arthrosis were old age at the time of surgery, obesity (BMI >30), female sex, the presence of cartilage lesions at the time of surgery and degenerative meniscal lesions. The functional IKDC scores revealed that as many as 48% of the patients enjoyed moderate to intense physical activity 22 years after procedure (71% before surgery). The subjective KOOS scores only fell from 82% to 69% during the same period. Although IKDC and KOOS scores were globally satisfactory, three subgroups of patients could be identified. The first sub-group (40% of the patients)

comprising young patients (<40 years of age), who did not have cartilage lesions at the time of surgery nor malalignment of the lower limbs, and who underwent partial meniscectomy (<2/3) for traumatic lesions, benefited from excellent surgical results. Asymptomatic arthrosis was found for the patients in the second sub-group (27% of the patients) which comprised older patients (average 37 years of age) who suffered from cartilage lesion at the time of surgery without malalignment of the lower limb. Patients in the third sub-group (30% of the patients) suffered from symptomatic osteoarthritis of the knee: they were older patients (average 40 years of age) with cartilage lesion and malalignment of the knee in valgus at the time of surgery, and who underwent extended meniscal resection for degenerative lesions. Based on this extensive review using internationally recognized scores and standardized radiological protocols, we recommend caution before proceeding to arthroscopic lateral meniscal resection for patients who are the most at risk of further developing knee arthrosis.

Postoperative serum Pro-Calcitonin and C-reactive protein levels in patients with orthopaedic infections

FM 31

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Introduction: The value of postoperative Pro-Calcitonin (PCT) levels in the follow-up of infected patients is unknown. The objective of this study was to compare the postoperative ultra-sensitive serum PCT and C-reactive protein (CRP) levels in infected orthopaedic patients and assess the utility of PCT in predicting the need for surgical re-intervention.

Methods: Retrospective study including adult orthopaedic patients at the Geneva University Hospital.

Results: A total of 165 paired PCT and CRP samples were retrieved in 60 patients (median age, 58 years, 17 females). Twenty-four patients required surgical re-intervention. Postoperative PCT values were elevated only in 15 patients. Median PCT levels exceeded normal only on the first postoperative day, despite a clinically active infection. PCT values did not differ between patient groups with one or more surgical interventions (Wilcoxon-ranksum-test, $p = 0.33$). CRP was elevated in 54 patients (90%), and normalized by the tenth day. Although paired samples, both markers correlated poorly with each other (Kendall-tau-test 0.47).

Conclusion: PCT has no predictive value for surgical re-interventions in patients with localized orthopaedic infections.

Antibiotic prophylaxis before invasive dental procedures in patients with hip and knee arthroplasties. Review and conclusions

FM 32

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Introduction: More than a million hip replacements are carried out each year worldwide and the number of other artificial joints inserted is also rising. With the increasing numbers of implants, infections associated with arthroplasties have become more common. However, there is a paucity of literature on infections of joint replacements due to hematogenous seeding following dental procedures.

Methods: We reviewed the published literature to gain a clearer insight into current knowledge on this problem and to determine the scientific evidence for routine antibiotic prophylaxis in this population prior to dental procedures.

Results: Based on our review, we found that antimicrobial prophylaxis before dental interventions for patients with artificial joints lacks evidence-based information

Conclusion: Antimicrobial prophylaxis before dental interventions cannot be recommended systematically.

Low incidence of haematogenous seeding to total hip and knee joint arthroplasties in patients with remote infections

FM 33

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Introduction: The exposure of arthroplasty patients to remote infections is unknown.

Methods: Prospective cohort study of elective hip and knee arthroplasties January 1996-November 2008 in Geneva University Hospitals. Retrospective documentation of remote infections occurring in hospitalised patients after arthroplasty.

Results: A total of 6101 episodes with 4002 hip (66%) and 2099 knee arthroplasties (34%) were retrieved. Among 71 infections, 64 (90%) were surgical site infections. Seven (total incidence 7/6101, 0.1%) were secondary to remote infections. Secondary infections occurred later post-surgery (on average 19 months vs. 46 months, Wilcoxon-rank sum test, $p = 0.024$); six of them even 24 months post-arthroplasty. The cohort patients faced 553 infections occurring after a median delay of 33 months post-arthroplasty, 61% after 24 months. In 23 episodes of remote infections (23/553, 4%) the patients were in septic shock and 25 patients died because of remote infection (5%). 39 episodes had an abscess and 81 were bacteraemic. None of them developed secondary arthroplasty infection. The ratio of secondary infections to potential exposure was 1:79. In multivariate analysis, a high Body Mass Index (OR 1.1, 95% CI 1.01-1.1) and revision arthroplasty (OR 2.7, 95% CI 1.1-6.9) were significantly associated with arthroplasty infections. There were no specific parameters detected for secondary infection.

Conclusion: Secondary arthroplasty infections are absolutely rare compared to the exposure the patients face after initial surgery. Infections and exposure occur both concomitantly after 24 months post-arthroplasty.

Swiss multicentric study on the long-term results of patients with Synovial Sarcoma

FM 34

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Introduction: Synovial Sarcoma is a malignant soft tissue sarcoma which mainly occurs in the age between 15 and 40 years. In this age group besides liposarcoma and rhabdomyosarcoma it is the most common malignant soft tissue sarcoma. It is an aggressive sarcoma with a poor prognosis through late local recurrence and a late onset of distant metastases. To our knowledge there is currently no study with a minimum followup of 10 years evaluating the long-term outcome of the tumor treatment.

Methods: In this retrospective multi-center-study which was performed in the major tumor centers in Switzerland we investigated 61 patients (26 male, 36 female) that had been treated for a Synovial Sarcoma between 1968 and 1999. The minimum followup was 10 years. The following parameters were examined for their potential prognostic value: Age at diagnosis, sex, tumor site, size, histology, histologic grade, fusion type and surgical treatment. The Kaplan-Meier method was used to estimate the survival rates.

Results: The mean age at diagnosis was 35,4 years (range, 6–82). The mean follow-up was 11,4 years (range 0.3–27.6). The mean follow-up of living patients was 17,2 (10.1–27.6), that of dead Patients 77 years (range, 0.3–19.6). The 5-year survival rate was 74.2%, the 10-year survival rate 61.2%, the 15-year survival rate was 46.5%. Overall survival was 38.7%. Local recurrence occurred after a mean time of 3.6 years (range, 0.5–14,9), metastases at a mean time of 5.7 years (range 0.5–16.3). Significant adverse prognostic factors include tumor size, metastases at the time diagnosis, high histologic grade, trunk related disease. Sex, histologic subtype as well as SYT-SSX fusion type were no significant prognostic factors.

Conclusion: With regard to the fact that metastases in patients with Synovial Sarcoma often occur late with a high mortality we recommend to follow the patient more than 10 years and treatment should be performed in a tumor center from the beginning on.

FM 35

Osteo-articular infections caused by *Kingella kingae* among children aged less than 3 years

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Introduction: *Kingella kingae* is an emerging pathogen, that is currently recognized as the first bacterial species responsible for osteo-articular infections (OAI) in children aged <3 years. Pathogenesis of the agent is linked to the production of a potent cytotoxin, known as RTX, which seems essential for inducing cytotoxic effects on respiratory epithelial, synovial and macrophage-like cells. However, clinical presentation of OAI infections caused by this microorganism may be very atypical, and usual blood tests as standard cultures often bring little of assistance to the diagnosis.

Study design: Cross sectional study (description of the frequency and characteristics of OAI in children aged <3 years, and evaluation of a new diagnostic test).

Intervention: The Microbiology Laboratory of the HUG has developed a novel real-time PCR assay that targets the RTX toxin gene. The assay appears 10-fold more sensitive than previously published broad-range 16S rRNA gene PCR, and shows no cross-reactivity with several related species and common osteoarticular pathogens.

Patients and methods: Since January 2007, specific or broad range PCR assays were performed on samples obtained at the site of infection from any children aged <3 years who were suspect of having an OAI. All children had simultaneously standard cultures and usual blood tests (haematological evaluation, CRP & ESR).

Outcome: From an epidemiologic point of view, this study confirmed that *K. kingae* has become the first bacterial species responsible for OAI in children aged <3 years. Moreover, it demonstrated that the predictive value of the classical infection predictors (T°, ESR, CRP, white count cells) was very low on the final diagnosis for *K. kingae* OAI. The new real-time PCR assay that targets the RTX toxin gene improved significantly the determination of microorganism responsible of OAI in children aged <3 years.

N: This study focuses on the atypical presentation and localization of *K. kingae* OAI, just as it shows the low assistance of usual blood tests and standard cultures to the diagnostic. The efficiency of the detection of the responsible microorganism is notably increased by the use of specific or broad range PCR assays.

FM 36

Squamous cell carcinoma in chronic osteomyelitis patients. Is it really so rare?

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Introduction: Development of a squamous cell carcinoma is a rare but well-known complication of chronic fistulating osteomyelitis. A high index of suspicion and high quality of histopathological control are paramount in order not to miss the correct diagnosis.

Methods: The clinicopathologic features of six squamous cell carcinoma occurring in long standing osteomyelitis patients are presented.

Results: There were two women and four men, whose age ranged from 52 to 67 years (median: 59). All had a long history (12, 19, 21, 30, 39 and 40 years) of chronic fistulating osteomyelitis, localized in lower (5 patients) and upper extremities (1). All tumors developed after 9–20 years of evolution and all were highly-differentiated squamous cell carcinomas on microscopic examination, involving the deep soft tissues and bone.

Conclusion: Malignant transformation of chronic fistulating osteomyelitis is a rare but treacherous event. It should always be suspected when facing changes in the clinical pattern of the disease. Multiple and, more importantly, deep biopsies are strongly recommended to avoid confusion between highly-differentiated squamous cell carcinoma and pseudoepitheliomatous hyperplasia. Early diagnosis and a team approach (orthopaedic and plastic surgeon) are crucial for optimal management of the patient.

FM 37

Osteomyelitis of the pubic symphysis due to *Streptococcus viridans*. A case report

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Introduction: An unusual case of septic arthritis of the pubic symphysis in a healthy fifth-seven years old woman. The isolated germ was streptococcus viridans. Healing occurred rapidly with the help of systemically given, adapted antibiotics. Septic arthritis of the pubic symphysis is rare. Of 738 cases of septic arthritis from 6 large series, none involved the pubic symphysis.

Methods: Septic arthritis leads to osseous destruction with possible formation of sequestrars demanding aggressive antibiotic therapy and often surgical management. Initial radiography showed erosion of the pubic symphysis and exams were completed by MRI, showing two abscesses posterior to the pubic symphysis in the space of Retzius. The possibility of a septic symphysitis was evoked and the abscesses were aspirated for bacteriology exam under computed tomography (CT). We introduced a systemic treatment by amoxicilline/clavulanic acid 2,2 gr 4 times per day. After 4 days bacteriologic results showed *Streptococcus viridans* mitis group (mitis, oralis, sanguis) and systemic antibiotherapy was changed to penicillin.

Results: Six days after antibiotics introduction, clinical evolution was good and the patient was rapidly able to walk without pain. Inflammatory parameters decreased with white cell count 6.2 G/l and CRP <2 mg/l.

Conclusion: Osteomyelitis of the pubic symphysis is rare. Definitive diagnosis can be made from blood cultures, fine needle aspiration, or open biopsy and curettage, the latter being not only diagnostic, but therapeutic. Blood cultures are unreliable, as 50% will be negative, as in the present case. CT-guided fine needle aspiration is a useful tool for obtaining a tissue diagnosis of the infection organism and establishing antibiotic sensitivities. It has been advocated as a first line intervention prior to open surgical biopsy and curettage.

FM 38

Transient synovitis of the hip: a review of management in Children's Hospital of Geneva

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Introduction: Evaluation of acute hip pain in children can be challenging, because there are several diagnoses to consider. Most patients have a transient synovitis of the hip, which is a benign and self-limited condition. However, its similarities with other more serious disease make the diagnosis one of exclusion. In the Children's Hospital of Geneva, children presenting with an acute hip pain are treated according to a specific protocol including blood sample with rheumatoid panel, hip ultrasound, and conventional X-rays. The objectives of our study were on one hand to evaluate the efficacy of the realized investigations on the final diagnosis and on the other hand to better characterize transient synovitis of the hip.

Methods: We retrospectively reviewed the medical records of children who had the investigation's protocol between 1999 and 2003.

Results: 269 medical records were reviewed comprising 66.2% of boys and 33.8% of girls, with a mean age of 5.5 years. Prior to presentation, 68.4% of children reported pain of <24 hours in duration. Limp or refusal to bear weight was observed in all cases. According to the Kocher's predictors of septic arthritis of the hip (fever, non weight-bearing, ESR >40 mm/h, serum WBC count of >12000 cells/mm³), none children had zero predictor, 269 had one, 40 two, 3 three, and none four. A positive rheumatoid factor test was found in 18% of children, whereas 16% of patients had a positive antinuclear antibody test. During hospitalisation one child was diagnosed as having septic arthritis. The remaining patients were diagnosed by exclusion as having a transient synovitis of the hip since clinical follow-up was normal at 6 weeks.

Conclusion: Transient synovitis of the hip is a diagnosis of exclusion, and septic arthritis is the main condition to rule out. Using Kocher's predictors of septic arthritis is useful for distinction between both conditions early at presentation. In our collective, only 3 patients with transient synovitis had a three of four predictors. Our study also showed that screening for a rheumatologic disease should not be done routinely at the first episode of hip pain. Indeed, positive tests were never confirmed with a clinical situation evocative of rheumatologic disease. More selective criteria should be used before doing a rheumatologic panel. Furthermore our work emphasizes the economical impact of a management of this frequent condition with less blood investigations.

Diagnosis and treatment of children and teenagers with hyperextension finger injuries

FM 39

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Introduction: Hand injuries – in particular finger injuries – are very frequent in children & teenagers. The hyperextension trauma of the proximal interphalangeal (PIP) joint caused by a ball (football, basketball, volleyball, rugby) is one of the most commonly occurring hand injuries. The diagnosis is made on the basis of a precise history taking and physical examination. Radiological studies of the affected digit are done to confirm the diagnosis, but rarely show an osteoarticular lesion. Furthermore, treatment and functional outcome are not modified with or without any radiological findings.

Patients and methods: We report on more than 300 cases of children aged between 8 and 15 years (mean age 11 years) treated for PIP hyperextension injuries caused by a ball at our institution over 5 years (2003–2007). This article reviews all elements in the management of PIP hyperextension trauma, including history taking, physical examination, radiological findings, treatment and functional outcome. Most of PIP hyperextension injuries from ball produce a rupture of the volar plate, with or without palmar epiphyseal avulsion fracture. The diagnosis of volar plate rupture can be formulated after a carefully conducted history taking and physical examination. Without any finger deformity, the treatment of choice is conservative and uses an immobilisation in a Houston cast for 10 days and then early mobilisation with syndactily. This leads in all cases to a good functional outcome after 3 weeks.

Discussion/conclusion: This retrospective study shows the lack of value of the imaging results in the management of PIP hyperextension injuries and proposes a management based on the mechanism of trauma and precise clinical examination rather than on the basis of radiographic findings. Furthermore our work emphasizes the economical impact of a management of these frequent injuries without radiological studies.

Treatment outcome of 144 prosthetic joint infections: Six weeks of antibiotic treatment are sufficient when surgery is performed

FM 40

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Introduction: The benefit of a prolonged antibiotic treatment of prosthetic joint infections (PJI) beyond 6 weeks after surgery is contested. We compare the incidence of cure according to the duration of antibiotic therapy (6 versus 12 weeks).

Methods: Retrospective study including orthopaedic patients with infections of total hip and knee joint replacements at Geneva University Hospitals (HUG) and Raymond Poincaré Hospital. Case control design using logistic regression analysis.

Results: A total of 144 PJI (75 in women, 69 in men, 20 diabetic patients, 16 patients with chronic alcoholism, median age 77 years) were retrieved. There were 62 total hip, 62 total knee arthroplasties, and 20 medullary prostheses with a median follow-up of 36 months post-surgery. 116 infections (81%) occurred in HUG, 28 in Garches. 84 episodes (58%) were due to *Staphylococcus* sp, of which 26 due to methicillin-resistant *S. aureus* (MRSA). Median number of surgical interventions for curative purposes was 1 (interquartile range 1–2) involving 60 debridements with retention of the implant, 10 one-stage exchanges, 57 two-stage exchanges (with a median time delay between of 14 weeks), and 17 Girdlestone procedures. 70 episodes (49%) were treated with 6 weeks, 74 with 12 weeks of antibiotics. Cure was achieved in 55 episodes (87%) and in 45 episodes (67%), respectively. When adjusted in multivariate analysis, only a two-stage procedure was statistically significantly associated with enhanced cure (odds ratio 3.5, 95% CI 1.1–10.9), whereas six weeks of antibiotic treatment (OR 2.4, 0.8–6.7), the duration of intravenous antibiotic administration (OR 1.0, 1.0–1.0), the hospital, sex, age, type of prosthesis, presence of a sinus tract, MRSA, the number of surgical interventions, and implant retention were not.

Conclusion: Provided that surgery has been performed, antibiotic treatment for PJI can be limited to 6 weeks postoperatively without enhanced the risk of recurrence.

Introduction of photodynamic therapy to human osteosarcoma cell lines

FM 41

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Introduction: Despite refined surgical techniques and chemotherapy regimens the 5-yr survival rate of osteosarcoma patients who present with metastasis is only 20%. Therefore, it is of the utmost importance to introduce more effective therapeutical methods mainly targeting metastatic disease in osteosarcoma to suppress the formation of metastases and to increase the 5-yr survival rate. Here, we introduced photodynamic therapy to human osteosarcoma cell lines using the photosensitizer Foslipos®. We tested the dose- and time-dependent uptake into four different human osteosarcoma cell lines, each consisting of one cell line with low metastatic potential and a corresponding highly metastatic derivative selected either in vivo (two cell lines) or in vitro (one cell line) or generated by Ki-ras transformation (one cell line). First dark- and phototoxicity experiments have been performed in one cell line.

Methods: Cells were incubated with either different doses of Foslipos (0.3–10 µg/ml) for 8 h or with 2.5 µg/ml for 0–24 h. Fluorescence intensity was measured by excitation at 417 nm and detection of emission at 652 nm. For dark- and phototoxicity cells were incubated with different doses of Foslipos (0.01–10 µg/ml) and either kept in the dark or illuminated with 2.5, 5 or 10 J/cm². Cell viability was determined 24h after illumination by WST-1 assay.

Results: Two of the tested cell line systems showed a higher fluorescence intensity after Foslipos incubation in the highly metastatic sublines compared to the corresponding low metastatic cell lines in a time and dose-dependent manner. First results show a dark-toxicity at high concentrations and killing of the cells after Foslipos uptake and illumination.

Conclusion: Two human osteosarcoma cell line systems show preferential uptake of the photosensitizer Foslipos to the highly metastatic sublines compared to their corresponding low metastatic cell lines. This is an important step for further studies of photodynamic therapy in osteosarcoma including in vivo studies on reduction of metastases formation.

Late diagnosed congenital hip dislocation in children

FM 42

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Introduction: Currently, most of authors recommend early open reduction combined with femoral shortening for late discovered congenital hip dislocation (CHD). Nevertheless, we feel that closed reduction under anaesthesia and arthrography after a period of traction remains an excellent therapeutic alternative.

Methods: Children aged from 3 to 24 months at the time of CHD diagnosis were included in this study. For children with irreducible hips, a conservative treatment comprising a period of traction, and then a closed reduction under anaesthesia and arthrography with or without adductorotomy was realized. The results were interpreted on the basis of the arthrography performed during the reduction and, on the residual hip dysplasia at the end of follow-up.

Results: Twelve girls with a mean age of 9.25 months (4–20 m) at the moment of the diagnosis were included in the study. Mean follow up was 4.5 years at last control (3–7.6 y). In all cases, CHD was unilateral, and a risk factor for CHD was found in only 1 child. According to Tönnis classification, there were 4 type II, and 8 type III CHD. All type II CHD were reducible at initial examination and treated by Pavlik harness during 5.6 months (3.5–9 m). Three of them needed an additional treatment by an abduction splint during 9 months (3–14 m). Tönnis III CHD (8 cases) were irreducible at initial examination and treated by closed reduction after a period of traction with progressive abduction of the hips. Mean duration of traction was 18.25 days (9–26 d). Closed reduction was thereafter realized successfully for all hips; tenotomy for contracted adductor muscles was realized in 4 children. None presented an obstacle during the hip reduction. On arthrography (6 exams), femoral head was concentrically reduced in all cases, and labrum was in a normal position in 4 children, and in an everted position for 2 patients. We noted no post reductional osteochondritis of the femoral head. At the last clinical control, all children walk without limping and range of motion was complete. Radiological coxometric measurements were normal excepted in one case (Tönnis III) which needed an additional procedure by a Salter osteotomy for a residual dysplasia.

Conclusion: In case of late discovered congenital hip dislocation in children aged from 3 to 24 months, we recommend a closed reduction supplemented by a secondary surgery type Salter osteotomy in the event of residual dysplasia.

FM 43

Rotator cuff tears treated with a modified deltoid flap repair technique

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Introduction: The treatment of irreparable rotator cuff tears is still problematic, especially in younger patients.

Materials and methods: We retrospectively reviewed the outcome of 57 (95%) out of 60 patients that had been treated by the senior author with a modified anterolateral deltoid flap technique for rotator cuff tears. The tear size measured less than 4 cm in 26 cases, and was larger in 34 cases. Indication for surgery was pain in 10 cases, pain and weakness in 42 cases, and pain with pseudoparalysis in 8 cases. Follow-up was on an average after 6 years (4–6).

Results: At latest follow-up, 83% considered the condition of their shoulder as better or much better compared to before surgery, 8% as similar and 8% as worse. The mean overall subjective shoulder value was 77% of the value for a normal shoulder. The mean Constant score was 86% ± 22 (29–122). Pain relief with no or only mild pain was obtained in 91% of the cases, 9% had moderate and no patient had severe pain at follow-up. Full flexion was found in 58% of the patients, flexion from 90°–150° was found in 33%, and 9% (5 patients) had a pseudoparalysis with flexion below 90°. Retears of the deltoid flap occurred in 8 patients (14%) 6 months to 5 years after the index operation; one of them was successfully treated with an inverted total shoulder replacement, 6 had a repair of the flap with only 2 satisfactory results.

Conclusions: The modified deltoid flap reconstruction yields reliable pain relief, a high rate of patient satisfaction and also satisfactory function for the majority of the patients in the treatment of irreparable, mainly supraspinatus tears. In selective cases, and especially in younger patients, this technique might be considered a viable alternative for the treatment of this difficult pathology.

FM 44

The seven portals method for simplified arthroscopic rotator cuff repair

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Introduction: With an experience of over 1000 arthroscopic rotator cuff (RC) repairs, we are aware of the importance of reproducible portals in order to gain speed at the operation and for teaching purposes. Over the years we have introduced 2 new portals in addition to the ones well described. An elaborate portal systematics is expected to increase operating success.

Technique: Surface anatomy of the acromion and clavicle are marked with a skin pen, and the lateral border of the acromion is divided into thirds. Four lateral portals are marked at a distance of 2 cm from the bony edge. The portals are termed (from a to p): 1. lateral anterosuperior portal (LASP), 2. lateral portal (LP), 3. accessory lateral portal (LP2), 4. and posterolateral portal (PLP). We additionally mark the posterior standard (SP) and anterosuperior standard portal (ASP), as well as the superomedial Neviaser portal (NP). The LASP has been described by us for SLAP repair (Arthroscopy 6/2006), but is equally appropriate for biceps tenodesis and suture passing in the anterior cuff. The LP, equipped with a 8 mm cannula, provides access to the center of the tear and facilitates knot tying. The LP2 (not described in the literature) is used as a viewing portal during most of the reconstruction work. The PLP serves as a viewing portal for acromioplasty and suture passing in the posterior cuff. We put special emphasis on switching the scope to the LP and introduce the shaver into the PLP, in order to perform a thorough posterolateral bursectomy.

Results: The seven portals method allows us to reconstruct all patterns and sizes of RC tears without obstruction of the view and "difficult angles". We have used this method successfully in the last 600 cases. Teaching is facilitated and the learning curve for younger colleagues is sped up. In a given period of operating time (average 80') we are able to perform more sophisticated procedures, compared to a single-row repair.

Conclusion: We recommend the use of seven standardized portals in arthroscopic RC repair. Dividing the lateral acromion into thirds to define 4 lateral portals and performing an early posterolateral bursectomy, has facilitated our operations to a great deal and proved its utility for teaching purposes.

FM 45

May absorbable suture anchors increase the rate of recurrent dislocations after shoulder stabilization?

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Introduction: Absorbable anchors are frequently used in shoulder surgery. Mechanisms of absorption induce a local inflammatory reaction. It is not clear if this process may disturb healing of the capsule and ligaments. The purpose of the study was to compare the rate of recurrent dislocation following open shoulder stabilization when using absorbable or non-absorbable suture anchors.

Methods: Between 1999 and 2003, 83 open Bankart repairs were performed by the same surgeon. All patients had recurrent traumatic anterior shoulder instability. All had preoperative arthro-MRI or arthro-CT which did not reveal any significant bony Bankart lesion or rotator cuff tear. Thirty-four patients were treated with absorbable anchors (Panalok[®]) and sutures (Panacryl[®]) and 49 with non-absorbable anchors (Mitek GII[®]) and sutures (Ethibond[®]). The same surgical technique and rehabilitation protocol were used. The incidence of sports ability and recurrent instability were recorded. We defined instability as true dislocation.

Results: Five patients on 34 were lost to follow-up in the absorbable group and 7 on 49 in the non-absorbable group. The mean age of absorbable group was 25 years (range, 17–39 years). At a mean follow-up of 66 months (range, 54–76 months), 86% could resume sports activity. Five patients on 29 (17%) reported recurrent instability and two did need revision surgery. The mean age in non-absorbable group was 28 year (range, 18–47 years). At a mean follow-up of 78 months (range, 49–82 months), 93% could resume sports activity. Three patients on 42 (7%) reported recurrent instability and one did need revision surgery.

Conclusion: This clinical study showed a clear tendency to a higher recurrence rate of dislocation when using absorbable suture anchors (17% in absorbable vs 7% in non-absorbable group). It is known that Panacryl[®] may be responsible for a major local inflammatory response. However, it is still unclear if this could be the failure etiology. Consequently, we prefer to use systematically non-absorbable suture anchors for shoulder stabilization.

FM 46

First results using new type of glenosphere in Reverse Shoulder Arthroplasty

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Background: One possibility for the surgical treatment of disabling shoulder arthropathy where anatomical total shoulder arthroplasty is limited is Reverse Total Shoulder Arthroplasty. First evaluation in our own patients so as in the whole literature by short and midterm results confirmed that positioning of the glenosphere and so the angle between the glenoid and the scapular neck is correlated with inferior scapular notching and so with good or poor clinical outcome. Lowering the centre of rotation of 4 mm with the eccentric glenosphere gave us, with a constant peg-glenoid rim distance, a reduced prosthesis-scapular-neck-angle; the same effect as described in literature by lowering the whole implant. We analyzed retrospectively our own short term results, comparing 36 mm glenosphere (group A, n = 36) with the new 36 mm eccentric (group B1, n = 46) and the 44 mm glenosphere (group B2, n = 35) in equal diagnosis so as secondary osteoarthritis (n = 77), primary irreparable rotator cuff arthropathy with pseudoparesis (n = 34) and revision after failed total shoulder arthroplasty (n = 6).

Methods: 117 patients (group A, B1 and B2; 2005 and 2006) were investigated by clinical exam, Xray and score in an average follow up of 14 months.

Results: In group A, 36% showed in the follow-up radiological changings with bony erosion on the scapular neck starting in an average postoperative time of 6.3 months, corresponding to inferior scapular notching (Nerot grade 1: 1, Nerot grade 2: 7, Nerot grade 3: 4, Nerot grade 4: 1). There was no bony erosion in group B1 and B2. We found better shoulder value (pain, adl) so as shoulder function (forward active flexion from av. 118° → av. 145°, active abduction from av. 85° → 125° and external rotation from av. 35° → 75°) in the B1 and B2 group comparing with the group A.

Conclusions: We attribute better clinical outcome in the first short term results to the lowering of the centre of rotation preserving the good bone stock in the middle of the glenoid for central peg fixation. We evitate inferior notching (which is associated with poor clinical outcome) reducing the prosthesis scapular neck angle with the glenoid rim overlap of 36 mm eccentric and 44 mm glenosphere. Major mobility, joint stability and patient's satisfaction in subjective shoulder value is encouraging and will lead us to look forward to improve long term results also by new technological materials.

FM 47

Sports activity after anatomic total shoulder arthroplasty

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Introduction: Implant survivorship extended clearly during the last decades by improving the systems of total shoulder arthroplasty (TSA). This leads to implantations in younger patients too. Especially in this patient group the level of sports activity matters. Therefore we collected additional data to a prospective cohort study with respect to level of sports activity.

Methods: One hundred consecutive patients with unilateral TSA (Promos™, Smith&Nephew AG) with a minimum follow up of 1 year were included in the study. Assessment preoperatively, 1 and 2 years after operation included clinical examination and validated questionnaires (Constant-, SPADI- and DASH Score and the SF36). In addition all patients received an in-house developed sports-questionnaire containing questions about their participation in sports before the shoulder disease, during the time of shoulder disease and postoperatively.

Results: 55 patients participated in sports before the shoulder disease (55%); after a mean follow-up of 2.8 years (1.3–4.6) 49 patients (89% of initially 55) were still able to participate in sports. 67% of them started with sports within 6 months after the operation. 17 of the initial 55 patients had to stop sports during their shoulder disease, 11 of them resumed their sports activity after TSA implantation but 6 did not start again. No patient had to stop sports due to TSA. Strength, range of motion as well as the physical component score of the SF36 and the Constant-Score after TSA were significantly better in the sports group (49/100) than in the non-sports group (45/100). Whereas the overall mean age at follow-up was 68.9 years (26–92) the mean age of the patients participating in sports was significantly lower (63 vs. 70, $p = 0.002$) than in the non-sports group.

Conclusions: Total shoulder arthroplasty enables participation in sports without significant restrictions concerning activity level. Other factors like age at implantation or motivation seem to have more influence on sports activities. Thorough information about the limits of a TSA are required prior to operation and during the rehabilitation process since these patients feel almost no limits in their sports activity.

FM 48

Does a novel design prevent scapular notching in inverse shoulder arthroplasty? Design rationale and early clinical results

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Introduction: Results following inverse shoulder arthroplasty are inconstant. While short term results are promising, scapular notching is a major problem leading to high failure rates and revisions. Complication rates up to 30% are reported. To reduce polyethylene wear and osteolysis a novel concept has been developed.

Methods: Inferior notching, osteolysis, uncoupling of the metaphyseal part and screw breakage are the main reasons for failure which have to be prevented. A dual peg design of the metaglene with CaP coating provides high primary and secondary stability. Inferior (excentric) fixation of the glenosphere on the metaglene prevents inferior notching. The couple polyethylene glenosphere and a metallic inlay, bevelled at its inferior part, permit the inlay to be thinner, preserving the metaphyseal bone stock. Furthermore, even if notching still occurs, we assume that metal abutment would not lead to polyethylene wear. This study is a prospective multicentric study on an inverse shoulder prosthesis (Affinis® inverse, Mathys Ltd Bettlach, Switzerland), which is running in 6 european hospitals since december 2007. All cases are included in this study.

Results: At submission deadline for the abstract, 90 cases were included. 6 were conversions from fracture prostheses, without need to exchange the stem. As early complications we found dislocations in 3 cases. Two of them had to be revised for a thicker insert and one was reduced without recurrence. All these three shoulders are now stable. There was one deep infection, but no uncoupling. Early clinical results are promising.

Conclusions: So far, early mechanical and clinical results are promising, and complication rate is low. Even though long term assessment is needed, we assume the notching to be reduced in quantity and quality, which would probably lead to less polyethylene wear and less osteolysis.

FM 49

Analyse of function in reverse shoulder arthroplasty

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Introduction: The semi-constrained shoulder prostheses improve active elevation in the absence of a functional rotator cuff by increasing deltoid tension. However, evaluations of functional outcomes of reverse shoulder arthroplasty (RSA) have revealed variable improvements in the range of motion. The purpose of this multicenter study was to examine the impact of arm lengthening on function and determine the ideal soft-tissue tension to provide the best functional outcome without increasing the risk of complications.

Methods: 183 RSA in 180 patients were included in this retrospective radiographic and clinical review with a minimum of one-year follow-up. Variations in humeral length, overall arm length, and height of the subacromial space were evaluated after RSA according to a previously defined protocol. These length measurements were correlated with clinical results.

Results: The mean elevation in case of postoperative shortening of the arm compared with contro-lateral side was 121° compared to 140° in patients with 0–1 cm of lengthening, to 144° with 1–2.5 cm, and to 147° in those with >2.5 cm of lengthening. Mean postoperative elevation was significantly poorer in case of shortening ($p < 0.001$).

Discussion: Postoperative function was linked to the restoration of a sufficient arm length. An objective intraoperative criterion to evaluate deltoid tension in the operating room is crucial in order to prevent insufficient deltoid tension and to avoid poor function or dislocation.

FM 50

Salvage reverse shoulder arthroplasty: medium-term results in patients under 65 years

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Introduction: Reverse shoulder arthroplasty (RSA) is a successful salvage procedure for elderly patients. RSA is currently not recommended for patients under 65 years without data to support this policy. This study evaluates results of RSA as a salvage procedure in a consecutive series of patients younger than 65 years.

Methods: Between 1997 and 2003, 39 RSA were implanted in 37 patients with an average age of 58 years (range, 44 to 65 years). There were 25 women and 12 men. Seven primary RSAs were performed for cuff tear arthropathy, 14 after failed rotator cuff surgery, 16 for failed arthroplasties and 2 for failed ORIF of proximal humerus. RSA was the primary procedure for 7 shoulders and the revision surgery for 32 cases, accounting for an average of 2.2 previous procedures (range, 1 to 5). All patients were pre- and postoperatively scored according to Constant (CS) and imaged with standard radiographs. All had a preoperative magnetic resonance arthrography.

Results: Thirty-one patients with 33 shoulders could be reviewed after a mean follow-up of 74 months (range, 36–133 months). Three patients had died from unrelated causes and 3 were lost to follow-up. At follow-up, 3 infected prosthesis and one aseptic glenoid loosening have been removed permanently. The mean CS in the remaining 29 cases increased from 21 points preoperatively to 50 points at 5 and 42 points at 8 years ($p < 0.01$). The mean CS for pain improved from 5.0 points to 10.8 at 5 and 9.0 points at 8 years ($p < 0.05$). The mean subjective shoulder value increased from 19% to 57% at 5 and 44% at 8 years ($p < 0.01$). The mean abduction and flexion improved from 50° to 97° and 51° to 103° respectively ($p < 0.01$). The mean CS was 43 points for cuff tear arthropathy, 52 points for failed cuff surgery and 45 points for prosthesis revision ($p > 0.05$). In addition to drainage of hematoma, we noted 16 (48%) revisions surgeries. There were 6 infections (18%), 3 recurrent dislocations (9%), 2 inlay dislocations (6%), 2 periprosthetic fractures (6%) and 3 (2 stem, 1 glenoid) aseptic loosening (9%). The aseptic survival rate of glenoid and humeral stem were 94% and 91% respectively.

Conclusion: Even with a progressive functional deterioration at middle-term and a revision rate of 48%, the functional results in the remaining prosthesis stays at least twice that of the preoperative. RSA should be reserved only as a salvage procedure in young patients, but it could represent a valuable alternative therapy in selected cases.

Peri-prosthetic stress fractures after reversed shoulder arthroplasty

FM 51

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Introduction: Reversed shoulder prostheses have a semi-congruent design. Furthermore, the center of rotation is inferiorly displaced and a significant tension in the deltoid is often necessary to ensure the joint stability. Consequently, stress transmitted to peri-prosthetic bone may be increased, and could lead to stress fractures. We review a series of patients after reversed shoulder arthroplasty (RSA) and look specifically at the occurrence of postoperative peri-prosthetic stress fractures.

Methods: Between 2001 and 2006, 46 consecutive RSA were performed. There were 26 women and 20 men with a mean age of 74 years (53–86). All had preoperative MRI or CT-scan, which did not reveal any fracture. All had a delto-pectoral approach with standard rehabilitation. Review was performed at a mean follow up of 30 months (6–60), and consisted of clinical and radiological (plain X-rays) examinations. Every time a fracture was suspected or in case of recurrent unexpected pain, CT-scan evaluations were performed. The occurrence of peri-prosthetic fractures was looked for.

Results: Three patients (7%) sustained a scapular fracture (1 spinal and 2 acromial) without any trauma, between 3 and 6 months after the RSA. Furthermore, one of these patients developed 3 months later a spontaneous clavicular fracture, leading to an overall stress fracture rate of 9%. The four fractures were treated conservatively. Three mal-unions and one acromial non-union occurred. The range of motion in abduction and flexion decreased significantly after the fracture and stayed limited in all cases. All the three patients reported a recurrence of pain.

Conclusion: Peri-prosthetic stress fractures, especially in the acromion and in the spine of the scapula are not unusual after RSA. The etiology is not well known. The increase of stress in peri-prosthetic bone may be due to the semi-congruent design and to an overtension of the deltoid. The management of this complication stays difficult. The conservative treatment leads to mal- or non-union, with persistent pain and limited range of motion.

Hemiarthroplasty for displaced proximal humerus fractures, preliminary results of two types of implants

FM 52

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Introduction: The goal of this study is to report the clinical and radiographic results of 2 types of implants used to treat 3 and 4 parts fractures of the proximal humerus.

Patients: Sixty patients (61 shoulders) were reviewed in this retrospective series. Thirtyeight women and 22 men were included, the mean age was 67. A group of 30 patients was managed with a "standard" implant, a second group of 30 patients (31 shoulders) was managed with a "fracture" implant. The delay between initial trauma and the surgical procedure was less than 4 weeks (1–30 days) for all patients.

Methods: All the procedures were carried out by a senior surgeon. The patients were reviewed by an independent observer with a mean follow-up of 63 months for a clinical and radiographic evaluation.

Results: In the "standard implant" group; the subjective evaluation (SSV score) was 69% (30–100%). The mean Constant score was 58 points (24–95). The radiographic analysis revealed a greater tuberosity that was considered migrated, not healed or lysed in 65% of cases. In the "fracture implant" group; the SSV score was 70% (20–100%). The mean Constant score was 68 points (33–95). The radiographic analysis revealed a greater tuberosity that was considered migrated, not healed or lysed in 27% of cases. The patients with a healed greater tuberosity in an adequate position had better Constant scores: 68 points versus 58 points for those with a greater tuberosity not healed/lysed or in a bad position ($p = 0.01$). A healed greater tuberosity in an adequate position was obtained more constantly for the patients in the "fracture implant" group ($p = 0.02$).

Conclusion: A healed greater tuberosity in an adequate position is a significant parameter influencing the outcome of hemiarthroplasty for proximal humerus fractures. A fracture-designed implant allows better greater tuberosity positioning and healing.

A reliable and simple solution for recalcitrant carpal tunnel syndrome: the hypothenar fat pad flap

FM 53

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Introduction: The incidence of failure in open carpal canal tunnel decompression varies from 10% to 25%. Recurrence is often the result of scarring of the median nerve. Conservative treatment or careful neurolysis are usually insufficient. The hypothenar fat pad flap (HTFPF) interposes adipose tissue from the hypothenar eminence and could offer a solution for patients with recalcitrant carpal tunnel syndrome (RCTS).

Methods: Between June 2004 and June 2006, 20 patients with recalcitrant carpal tunnel syndrome (inclusion criteria by Stryckland), were managed with hypothenar fat pad flap and followed at our institution for a period of at least 12 months (mean 13, range 12–24 months). There were 12 females and 8 males, mean age was 56 years, range 38–85. Subjective complaints were evaluated. The shortened Quick DASH questionnaire (disabilities of the arm, shoulder and hand) was used to evaluate the disability experienced and also to monitor changes in symptoms and function over time.

Results: Pain completely disappeared in 18/20 patients. The 2-point-discrimination improved from an expanded range to normal in 16/20 patients. The Quick DASH score improved significantly: mean 33.6 at 3 months (median: 34.1; range: 13.7–79.5 / workers compensation group mean: 37.8; non workers compensation group: 28.5); mean 18.2 at 12 months (median: 13.6; range: 9.1–75 / workers compensation group mean: 22.6; non workers compensation group: 12.8).

Conclusion: The hypothenar fat pad flap is a technically simple procedure preventing median nerve re-adherence. It gives excellent results and should be considered as part of the arsenal of any surgeon dealing with carpal tunnel surgery.

Elastic, stable intramedullary nailing (ESIN) with titanium nails in displaced midclavicular fractures

FM 54

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Abstract: Elastic, stable intramedullary nailing (ESIN) with titanium nails is a promising minimal treatment for displaced midclavicular fractures, which may be an alternative to plate fixation (ORIF) and also to nonoperative treatment. A number of recent studies that have concentrated on completely displaced, mid-shaft fractures of the clavicle reveal nonunion rates between 15–20% (Mc Kee et al., 2003). The aim of this prospective study is to demonstrate that ESIN-osteosynthesis should be recommended as a valid alternative to conservative treatment because of early pain relief, associated rapid functional recovery and anatomical restoration of the clavicle with a less common nonunion rate.

Material and methods: The nail was used to 10 patients between January and September 2008 by two surgeons. Shortening of the clavicle of >1.5 cm and a midshaft dislocation of the shaft-diameter were the criteria of selection. One nail was inserted in retrograd direction at the acromial end and nine in anterograd direction at the medial extremity of the clavicle. Open fracture reduction via an additional small incision was necessary in all of the 10 patients. The mean age of the patients was 42.9 years (9 men, 1 women). Patients were evaluated before and after surgery for shoulder function and subjective pain (DASH-score). After the operation, radiological assessments documented fracture healing, and clinical outcomes scores were obtained. Time required to daily activities and return to work was documented. Postoperatively, no immobilization is performed. Patients were encouraged after two weeks to move the arm as much as tolerated and to use it in daily activities without lifting the upper extremity >10 kg.

Results: Mean (SD) shoulder abduction increased from 36.3° before surgery to 154.2° afterwards. Mean subjective overall satisfaction score using a visual analogue scale (0–10) decreased from 2.7 points before surgery to 8.25 points three days after. There were no complications after the operation. Hospital stay averaged 2.9 days. The mean operation time was 64.42 minutes.

Conclusion: Intramedullary fixation of displaced midclavicular fractures was successful in terms of clinical outcome and rapid resumption of general activities. This treatment should be offered to patients as an alternative to non-operative treatment or ORIF.

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FM 55

Navigated total hip arthroplasty (THR) using a 3D-freehand ultrasound system- preliminary results and feasibility study

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Introduction: We intend to present our technique, pitfalls and preliminary results of the first consecutive 10 patients operated with a novel 3D-freehand ultrasound system for navigated total hip replacement. The clinical applicability, specific problems and limitations are discussed.

Methods: Ultrasound navigated cementless THR (Zweymueller rectangular stem, MPF cup, Smith&Nephew, Aarau, Switzerland; ceramic/oxinium head, Ceramtec, Stuttgart) was performed in a total of 10 consecutive patients (m:f = 5:5, median age 74 years with range 60–87 years) with primary osteoarthritis of the hip. An ultrasound imaging system with a 5–10 MHz linear probe was used together with an infrared optical localizer system. Preoperatively the pelvic orientation was determined with conventional pointer and ultrasound-based registration of the landmarks. The pre- and intraoperative data of the navigational system including cup inclination, anteversion, leg length, range of motion and offset changes were documented for each patient.

Results: All landmarks were registered with the ultrasound probe without complications. The median image acquisition time was 10 minutes (range 6–16 minutes). There were no intra- or postoperative complications related to the use of any part of the navigation equipment. In 10 of 10 patients complete and plausible data sets were recorded using ultrasound. The main difference between the palpated and automatically determined ultrasound APP was in pelvic tilt (rotation around the transversal axis) mean $10^\circ \pm 2.6$ [median 10° , minimum 5.5, maximum 13.0]. For rotation around the longitudinal axis mean $0^\circ \pm 1.1$ [median 0° , minimum -1.5, maximum 1.5] as well as around the sagittal axis mean $0^\circ \pm 2.9$ [median 0° , minimum -3.5, maximum 3.0] there were minor deviations. The resulting difference for the cup orientation angles were for anteversion mean $7^\circ \pm 2.4$ [median 7° , minimum -4, maximum 9.5] and for inclination mean $3^\circ \pm 3$ [median 5° , minimum -1.0, maximum 5.5]. The APP calculated by the automatic procedure was found to be accurate and robust.

Conclusion: Ultrasound supported navigation in THR is a promising technology which could eliminate systematic errors in cup orientation in comparison to navigated THR using epidigitized references or THR without navigational support. The intraoperative application with a special patient draping is possible requiring additional time of 15–20 min in the OR. The GUI guidance with automatic on-line image segmentation and easy ultrasound parameter setting simplified the acquisition of good images. Still improvements in acquisition workflow and user guidance are needed to lower the learning curve.

FM 56

Accuracy of CT-free Computer Navigation in Less Invasive Total Hip Replacement

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Purpose: Less invasive (LIS) total hip replacement (THR) may be a challenge in setting and positioning of the components due to lesser visualisation and more soft tissue tension. The steep learning curve is well accepted. To reduce the complication rate we used a CT-free computer navigation to control inclination and anteversion of the cup as well as the femoral offset and the leg length.

Method: We analysed a prospective series of 68 cementless hips with ceramic on ceramic articulation in 68 patients (27 male, 41 female) which were all implanted by a single surgeon. In all cases a CT-free navigation system was used to control the cup inclination, the femoral offset and leg length. On standardized x-rays we measured the 3 parameters pre- and postoperatively and compared the results to those indicated by the navigation system.

Results: The average cup-inclination indicated by navigation was 42.2° (38° to 52°) compared to a mean of 44.5° (38° – 52°) on postoperative x-rays. The average difference between the data of the computer and the x-ray was 4° which is corresponding to the accuracy of angle measurement in standard x-rays. The average difference between the navigation and x-rays for the offset was 6.1 mm (0–24 mm), the one for the leg length 3.7mm (0–18 mm).

Conclusion: When deciding to use a less invasive approach for THR you can compensate less view and decrease early complication rate due to malpositioning by using a CT-free computer navigation system. The navigation helps mainly to control inclination of the cup but is also a valid assistance for restoration of the leg length and of the femoral offset. The value for the anteversion of the cup will have to be controlled by CT scans. Computernavigation has become to a standard procedure for all of our LIS TKR.

FM 58

Trial head navigation: A simple method to position total hip components in the safe-zone for optimal range of movement using a special trial head

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Introduction: In total hip arthroplasty (THA) clinical experience and mathematical analysis demonstrate that a maximized range of movement (ROM) without prosthetic impingement can be achieved when components are positioned in a compliant orientation to each other. This study shows how the correct relative orientation can be achieved and controlled intraoperatively using a specially designed trial head. The aim is to correctly align both components without using additional electronic equipment intraoperatively. Furthermore, there should be no need for a major modification of established surgical procedures and the method should be applicable in all approaches.

Material and methods: Based on a three-dimensional geometric mathematical computer model of a total hip arthroplasty implanted in a human pelvis the optimal orientation of cup and stem relative to each other was determined for a standard total hip prosthesis. This relative orientation was transferred to the special trial head in such a way that it does indicate how to orientate cup and stem during implantation only by positioning the patient in the lateral or decubital position. This trial head was used in a hundred of surgical total hip procedures including minimal-invasive total hip implantation with modular components.

Results: This trial head is a valuable tool in controlling the relative orientation of cup and head during trial reduction. In the stem-first procedure it shows how to orientate the cup during impaction so that it combines optimally to the neck of the stem in accordance to the safe-zone. In all of our patients the total hip components could be positioned in their prosthesis-specific safe-zone using this trial head. No dislocation occurred in any of the patients within the two year postoperative period. No adverse effect like squeaking occurred in patients with ceramic-on-ceramic bearing.

Conclusion: This trial head strongly supports the surgeons in aligning cup and stem in the correct orientation according to the safe-zone during surgery. It helps to greatly reduce the rate of dislocations and to get an optimal ROM. There is no need to use computer based navigation tools intraoperatively. It can be used in any standard or minimal-invasive approaches where an adequate view onto the prosthesis head is enabled. It fits quite well into common standard surgical procedures and no additional operating time is consumed.

FM 59

Reduction of complication rate in navigated less invasive total hip replacement by experience, implant selection and approach modification

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Introduction: Less invasive approaches (LIS) in Total Hip Replacement (TKR) pose a challenge on implantation and positioning of the components. This applies especially for the beginning of the learning curve and for extension of the indication on muscular patients or difficult hips.

Methods: Within a retrospective study we analyzed the first 68 LIS-TKR implanted with a CT-free navigation by a single surgeon from June 2005 to December 2008 concerning number, severity and character of the complications before and after changing the approach and design of the stem. In all hips cementless pressfit cups, cementless stems and ceramic on ceramic articulations were used. The first 47 hips – carefully selected out of 142 (33%) cases for LIS TKR – were implanted from June 2005 to June 2008 with an anterolateral approach according to Röttinger and a standard proximal anchoring cementless stem. The next consecutive 21 TKR until December 2008 were all implanted less invasively. They were performed after additional training of the surgeon in a modified anterolateral approach according to Pflüger. For this series an adapted, distally anchoring cementless stem for LIS TKR was used.

Results: The 1st group had 6 (12,7%) major complications which needed revision of in 5 (10,6%) cases in the first 6 months after primary intervention. In the second group there was only one patient (4,7%) with a complication followed by revision. Concerning the minor complications the 1st group had 8 (17%) events, the second 3 (14%). None of the patients developed infection, thrombosis, nervous or vascular lesions.

Conclusion: In our experience severe early complications in computer navigated less invasive hip replacement performed through an anterolateral approach could be reduced by about a half by education and experience of the surgeon and staff, selection of an adapted stem and modification of the approach. This improvement resulted despite the fact that in the second group the selection criteria for LIS TKR were abandoned. By using the CT-free navigation mal-positioning of the components could be avoided from the very beginning of our less invasive hip surgery.

FM 60

MIS in THR – Analyze of surgical mistakes after 44 workshops

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Introduction: The minimally invasive surgery performed via the anterolateral approach is for us the method of choice in total hip replacement. In this study we present our experiences as instructors with major problems in MIS-THR after 44 anatomical workshops in a period of 3½ years.

Methods: Our workshops are performed with eight surgeons operating on fresh human cadavers each time with one set of instruments under operative condition. For implantation we use the SL-Plus® MIA hip stem and Bicon+ cup with modified instruments.

Results: The following surgical mistakes occurred: wrong placement of skin incision, which prevents a correct portal and precise positioning of instruments, incorrect splitting of the IT band between tensor fascia lata and the gluteus muscle (ventral located incision through the tensor fascia leads to poor sutures), minor exposure of the joint capsule, no exposure of the reflected head of the rectus femoris tendon and missing incision of it to facilitate the approach to acetabulum, longitudinal capsular incision (parallel to the neck axis) not as medial as demanded, incorrect preparation of the capsular flaps (especially of the lateral flap) as a guide for release, insufficient success of the proximal capsule from the acetabular margin, wrong positioning of retractors and insufficient exposure of the proximal femur (an extended release of the trochanteric fossa is the key for sufficient access to the femoral canal), removing the osteotomised head fragment not in a flexed position and wrong pathway of rasp during shaft preparation.

Conclusion: Also for experienced hip surgeons starting with minimally invasive hip surgery it should be the aim to avoid a long-term learning curve which means “suffering period” for the patient. To ensure the benefits in minimally invasive surgery in total hip arthroplasty adequate knowledge of anatomy and surgical technique are demanded. The attendance in wet-labs helps to get the surgical details for successful THR.

FM 62

Minimal-invasive anterior total hip implantation with fracture table as the standard procedure: Experiences after 200 patients in Schaffhausen

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Introduction: Minimal-invasive total hip arthroplasty has opened new options for the early postoperative mobilization of patients and for the postoperative physiotherapy. Starting in November 2006 all primary total implantations and all hemiarthroplasties after femoral neck fractures are performed via the anterior approach in Schaffhausen using a proper type of a fracture table as a leg holder. We report on our experiences using this surgical technique as the standard procedure in all our patients.

Material and methods: The data of the first 200 patients were evaluated. Indications for joint replacement, age and gender distribution are in common well-known ranges. All patients irrespective of their BMI were operated on using the minimal-invasive anterior approach. Patients with revisions were excluded from further investigation.

Results: Time till full weight bearing varies between one to six weeks. There was no deep venous thrombosis, no ectopic ossification could be observed. Nevertheless, there were two dislocations treated by closed reduction and two deep wound infections that required a two stage revision. In the beginning fractures of the tip of the trochanteric tip occurred occasionally. A small number of cups were implanted in a higher inclination, i.e. more than 50 degrees. Also in the beginning leg length discrepancies up to one centimeter could be observed.

Conclusion: The rate of complications that was higher in the beginning could be cut. Hence, the surgical and therapeutic procedure including the proprietary type of fracture table, that has been established in our clinic has stood the test of time and will be continued. Additional introduction of a wound retraction system did improve the surgical procedure even more.

FM 61

Harding vs. OCM-approach in THA: Is there a difference in early outcome?

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Introduction: We retrospectively assessed three months postoperative functional outcome and heterotopic bone formation (HBF) in total hip arthroplasty (THA) using an antero-lateral minimal invasive approach (OCM) vs. conventional transgluteal Harding approach (TG).

Material and methods: Preoperatively and three months postoperatively 47 patients with OCM approach (47 hips, 30F, 17M, 68 ± 11,7a) and 54 patients using Harding's approach (59 hips, 28F, 31M, 71 ± 8,6a) were assessed (Brooker classification, Merle d'Aubigné-Score, ROM (flex, ext, IR and ER)). Statistic evaluation was performed by using the relative treatment effects (RTE).

Results: Neither gender specific nor approach related differences in the Merle d'Aubigné-Score, HBF formation, and ER could be found. In flexion there was a slight gender specific but no approach related difference (preop RTE 0.33 postop RTE 0.51 (p 0.00); females 0.48, males 0.51 (p 0.04). IR: preop RTE 0.33, postop RTE 0.39 (p 0.00); preop OCM RTE 0.32/TG RTE 0.34, postop OCM RTE 0.6/TG RTE 0.48 (p 0.052); females RTE 0.52, males RTE 0.46 (p 0.03). Extension: preop RTE 0.38, postop RTE 0.54 (p 0.00); preop OCM RTE 0.43/TG RTE 0.33, postop MIS RTE 0.58/TG RTE 0.5 (p 0.01); females RTE 0.52, males RTE 0.46 (p 0.051).

Discussion/conclusion: In the literature improvement of early postoperative outcome after THA using a MIS approach is controversially discussed (1,2). In our study 3 months postoperatively ROM and Merle d'Aubigné-Score improved equally in both groups independent of the approach. There was no difference in HBF. We could only show slightly significant improval of IR and ext using the MIS approach. A prospective study with a higher caseload would be required proving the latter.

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FM 63

Influence of obesity on stem osteolysis 5–10 years after total hip arthroplasty

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Introduction: Among patients undergoing total hip arthroplasty (THA), 24–36% are obese. Moreover, it has been reported that the age at which surgery is required is significantly decreasing with increasing body mass index. The literature about the effect of obesity on the occurrence of osteolysis around the femoral stem is sparse and controversial, and adjustment for patient activity is mostly lacking. Our aim was to evaluate the influence of body mass index (BMI) on osteolysis 5–10 years after THA.

Methods: We conducted a prospective cohort study of patients with hybrid THAs (uncemented cup, cemented stem, 28mm head and ceramic-polyethylene bearing surface) operated between March 1996 and December 2003. To be included all had to be seen either at the 5 or the 10-year follow-up visit, with complete information on BMI and activity and a radiological follow-up. BMI was evaluated as continuous variable and in four categories (<25, 25–29.9 (reference category), 30–34.9 and ≥35 kg/m²). Activity was assessed using the University of California, Los Angeles (UCLA) activity scale (1–10 points). Main outcome was the radiological assessment of osteolysis.

Results: 486 THAs, 280 in women and 206 in men, were included. Mean age at the time of operation was 67.7 years (±10.1). 49% of the patients were seen at 5 years and 51% at 10 years post-operative (mean follow-up 94 months). Osteolytic lesions were identified in 42 cases, in 24 of 181 normal weight (13.3%), in 7 of 182 overweight (3.8%), in 8 of 90 obese (8.9%), and in 3 of 33 severely obese patients (9.1%). Activity was highest in normal weight patients (mean UCLA score 5.6, ±2.0) and lowest in patients with a BMI ≥35 kg/m² (mean UCLA score 4.6, ±1.5). Univariate as well as multivariate logistic regression analysis adjusting for activity, age, sex and time to follow-up, did not show an increased risk of osteolysis in obese patients compared to overweight patients (adjusted OR 1.4, 95% CI 0.6;3.0).

Conclusions: In this study no increased risk for stem osteolysis was found in obese patients 5–10 years after primary THA.

FM 64

Highly crosslinked Polyethylene versus contemporary Polyethylene. A follow-up study, at least 5–8 yrs after primary implantation

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Objectives: Between 1987 and 2003 we implanted 1094 uncemented titanium hip prostheses (Zweymüller) with the articulation ceramic-contemporary polyethylene and between 2000–2003 we used the same uncemented titanium implant in 310 hips with highly crosslinked polyethylene (Durasul).

Methods: Clinical and radiological follow-up examinations were performed 3 months, 1, 2, 5 and 10 years after the implantation with a special regard to radiological wear associated alterations, such as eccentric inlay deformations, radiolucent lines and osteolysis.

Results: The 5 year survival rate after Kaplan and Meier, in reference to every revision, is 99.7% for the conventional polyethylene, whereas all 256 implants with highly crosslinked polyethylene had no signs of loosening with a survival rate of 100%. X-ray examinations at the 5 yrs follow-up: The contemporary polyethylene presented in 52.6% wear associated alterations such as inlay deformations of 1–3 mm, radiolucent lines or progressive osteolysis, whereas in the group with highly crosslinked polyethylene we detected only in 35% slight radiolucent lines with no progression and no inlay deformation. Only at the 2 years follow-up 1 osteolysis with no further progression at the 5 yrs review. This osteolysis got probably induced by a scratch on the metal ballhead.

Conclusions: In comparison to the contemporary Polyethylene (UHWMP) highly crosslinked Polyethylene achieved at the 5 yrs follow up a significant reduction of all wear associated x-ray alterations.

FM 65

Does hip resurfacing require larger acetabular cups than conventional total hip arthroplasty?

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Introduction: Hip resurfacing is femoral bone preserving, but there is controversy regarding the amount of bone removed at the acetabular side. We therefore compared the implanted acetabular cup sizes in primary total hip arthroplasties (THA) between two resurfacing devices and a conventional press-fit cup.

Methods: We analyzed a consecutive series of 2134 THAs (Allofit[®] cup 1643 hips, Durom[®] Hip Resurfacing 249 hips, and Birmingham Hip[®] Resurfacing (BHR[®]) 242 hips). After controlling for gender, patients were matched for height, weight, BMI, and age. We mean sizes of the implanted cups were compared between the matched groups and the effects of patient demographics and cup position in the horizontal plane also were assessed.

Results: The mean size for Allofit[®] cups was significantly smaller than that for Durom[®] and BHR[®] cups in women (49.9 mm, 51.6 mm, 52.3 mm, respectively; $p < 0.01$) and men (55.1 mm, 56.7 mm, 57.8 mm, respectively; $p < 0.001$). While patient height was associated with the implanted cup size ($r = 0.67$; $p < 0.001$), the cup position in the horizontal plane had no effect on the size used ($p > 0.05$).

Conclusion: Hip resurfacing required larger cups than THA with a conventional press-fit cup. However, additional studies are needed to determine whether these small differences have any clinical implications in the long-term. The strong association of cup size and patient height should be considered in future studies comparing component sizes among different implants.

FM 66

Cup diameter and risk of dislocation after primary total hip arthroplasty

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Introduction: The relationship between femoral head size and risk of dislocation has been studied extensively, but we are aware of only one study* with a small number of patients that investigated the influence of cup diameter on the risk of dislocation. The objective of our study was to evaluate the relationship between cup diameter and risk of dislocation within a large group of patients with the same type of implant and femoral head size while taking into account other known risk factors.

Methods: We conducted a prospective cohort study of all patients undergoing primary total hip arthroplasty (THA) (hybrid prosthesis, 28mm femoral head, transgluteal approach) between March 1996 and July 2008 at a University hospital. Cup diameter was analysed as a categorical (ranging from 44 mm to 64 mm) and as a dichotomized

variable (< 56 mm vs. ≥ 56 mm). The main outcome was the occurrence of dislocation. Potential confounders evaluated in multivariate logistic regression analysis were age, sex, BMI, co-morbidities, diagnosis, surgeon experience, and bearing surface.

Results: 2,793 THAs were included (1,222 in men, 1,571 in women). Mean age was 70.4 years (± 10.3). Overall, there were 60 dislocations, 38 (1.7%) in 2,278 patients with a diameter < 56 mm, and 22 (4.3%) in 515 patients with a diameter ≥ 56 mm. Dislocation risk in the smaller diameter group varied between 1.2 and 2.4%, whereas risks in the other group varied between 4.1 and 5.1%. Multivariate logistic regression comparing the dislocation risk in the larger to the smaller cup diameter group while adjusting for confounding, revealed an adjusted odds ratio of 2.0 (95% CI 1.1; 3.4, $p = 0.036$).

Conclusion: In patients with a hybrid THA and 28 mm head, we found a 2 times greater risk of dislocation among those with a larger cup diameter (≥ 56 mm). These findings confirm the results of the previous study*, which attributed this to a possible anatomic mismatch between cup and femoral head diameter, pseudocapsule attachment or prosthetic impingement. Our results support the use of a 28 mm head with smaller cup diameters (< 56 mm). With greater diameters it might be reasonable to increase the head size in order to reduce the incidence of dislocation.

*Ref.: S. Kelley et al. Relationship of femoral head and acetabular size to the prevalence of dislocation. CORR 1998.

FM 67

SL-Plus[®] MIA stem – complication analyse after more than 1000 implants

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Introduction: The SL-Plus[®] MIA stem, a modified implant system of the well established Zweymüller SL-Plus system, was designed to spare bone loss and to reduce soft tissue trauma, especially of the gluteus medius & minimus muscles and their tendons. Modifications were made exclusively in the lateral proximal part, which allows an easier operation technique in MIS. The aim of this study was to investigate the performance of this stem in cementless THR.

Methods: Since December 2005 we evaluated 720 SL-Plus[®] MIA stem implantations via MIS with anterolateral approach (modified Watson Jones) with follow up of more than one year. We evaluated 720 implantations. A variety of data were registered like Harris hip score, size and positioning of the implants, general and local early complications. Follow up evaluation were done at 6 & 12 weeks as well as 6, 12 & 24 month postoperatively clinically and by X-ray.

Results: The Harris hip score increased from 43 points to 95 points after 6 weeks postoperatively. A moderate varus position of implants (4–5°) occurred only in 7%. In 82% no radiolucent lines were found. The presence of radiolucent lines appeared in 18% after one and two years of follow up (RLs 1–2 mm: 11% in Gruen zones 1/7 and 8/14, RLs > 2 mm: 7% in Gruen zones 1/7 and 8/14) without necessity of revision. There was no intraoperative trochanteric or femoral shaft fracture. Complications included 6 dislocations after inadequate behaviour (0,8%), ossifications with level 3 & 4 in 5 cases (0,7%), 8 posttraumatic shaft fissures (1,1%) and one fracture caused by osteopenia (0,1%).

Conclusion: The short-term results of the SL-Plus[®] MIA stem show a remarkable low complication rate. The advantages of the new stem design are less trauma for gluteal muscles, less risk of trochanteric fracture by preserving trochanteric cortical bone, tendency of less radiolucent lines without clinical consequences and easier implantation technique for MIS. We expect at least the same long-term results as from the SL-Plus[®].

FM 68

The SL-PLUS-MIA-Stem. Results after two years and more

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The SL-Standard-stem called "Zweymüller" has proved itself to be one of the best since more than 25 years. Though, for the new minimal invasive approaches, it showed serious disadvantages. Particularly the protruding shoulder of the prosthesis asks for quite a large lateral exposition of the soft parts and weakens the trochanter. Together with the manufacturers of this product, a study group has created a modified SL-stem, reducing the shoulderprofile in the trochanter area without changing the diaphyseal anchorage. A newly refined range of instruments allows a minimal invasive, antero-lateral approach with the patient in supine position. The handling of the reamer and the implantation of the stem are carried out via a new entering curve. Out of 500, about 250 surgeries have been executed with the help of a navigation system. Since 2005, the two authors, who are also members of the study group, have implanted over 500 SL-Plus-MIA-stems. 185 implants – 177 patients, fem. 112, masc. 65, 8 patients have

been operated on both sides – have been checked upon after more than two years. In 175 cases, the clinical progression was without pathological findings, the patients were free of pain after 3 months, and without limping signs after 6 months. The X-rays after 6 and 12 months show a healthy osseous integration of the stem in all 175 cases. One low-grade infection with Propioni led to a stem loosening, the stem had to be changed after one year. One infection with staph. epidermidis could be healed after two debridements and a 3 months application of antibiotics without any signs of a stem loosening. One prosthesis dislocation led to a change of the cup. 3 patients suffered

from a one time dislocation. In 3 cases we observed scissures on the femur. One overweight patient suffered from an aseptic loosening of the stem after one year. The SL-PLUS-MIA-stem as in a modification of the SL-stem Zweymüller, facilitates the minimal-invasive implantation technique and preserves the structures of the trochanter. The successful diaphyseal anchorage leads to results which are similar to the ordinary SL-stem. Specific complications concerning this new implant have not surfaced.

Free communications VII

FM 69

Extreme motion as a potential initiator of hip osteoarthritis

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Introduction: A dynamic study of the hip in extreme positions (e.g., split) has never been investigated. It is also unknown if repetitive and extreme motion can lead to early osteoarthritis through excessive cartilage deformations. We present the preliminary results of a prospective study conducted with female professional ballet dancers. The aim of this study is to visualize in 3D extreme ranges of motion of the hip and to detect potential femoroacetabular impingements (FAI), based on computer-assisted techniques.

Methods: 10 volunteers (17–37 yrs) underwent an optical motion capture session. This system allows us to estimate the hip joint kinematics from 3D skin markers trajectories tracked with infrared cameras. The resulting computed motions (6 dancing postures) were applied to patient-specific hip joint 3D models reconstructed from MRI data. While visualizing the dancer's hip joint in motion, a collision detection algorithm was used to locate abnormal contacts between the femur and the labrum. Moreover, the surface-to-surface distance (i.e., penetration depth) was computed in order to estimate the overall FAI. Finally, the simulation results were compared with the radiological analysis.

Results: For more than 60% of the dancers' hips, lesions were diagnosed in the posterosuperior part of the acetabular rim. The hips did not present any cam or pincer morphology. The simulation showed that strong collisions occurred at extreme hip flexions or abductions between the mid-femoral neck and the superior or posterosuperior acetabular rim. 70% of the labral collisions were located in the superior or posterosuperior area of the acetabular rim and this was correlated with diagnosed labral lesions. The mean penetration depth (std. dev.) was 2.98 mm (2.17 mm).

Conclusion: Thanks to the use of motion capture, a new kind of FAI ("the mid-femoral neck FAI") has been actively demonstrated in vivo. Repetitive extreme motion could be thus a potential cause for the development of hip pain and osteoarthritis.

FM 70

Professional dancers' hip: correlation of clinical and MRI findings

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Background: Professional ballet dancers use extreme hip range of motion to achieve ideal ballet technique. The aim of the study was to clinically evaluate professional dancers hip and to correlate the findings to MRI examination.

Material and methods: 20 professional female ballet dancers completed questionnaires specifically looking at pain and activities in dancing. All dancers underwent a complete physical examination of the hip. MRI in supine position and while doing splits was performed and followed by motion capture.

Results: 12 dancers complained of inguinal hip pain (VAS 2-6) while doing «grand battement à la seconde», «grand plié» and «développé à la seconde». Pain could be reproduced by the anterior impingement test for 7 of them. The main hip range of motion (ROM) in flexion/extension is 133/0/19 (range 115-150/0/10-25), and 33/0/56 (range 5-50/0/30-80) in internal/external rotation (supine, 90° hip flexion). The 20 dancers could be divided in 4 groups: 1- pain and lesions on MRI (11 dancers), 2- pain and normal MRI (1 dancer), 3- no pain but lesions on MRI (3 dancers), 4- no pain and normal MRI (5 dancers). Out of the 11 dancers with hip pain and labral and/or cartilaginous lesions on MRI (group 1), alpha angle, acetabular depth and neck-shaft angle were

normal, except for one of them who had an alpha angle of 66° and 76° at anterior and anterosuperior position respectively, corresponding to a cam morphology.

Conclusion: Professional ballet dancers presenting hip pain have labrum and/or acetabular cartilaginous lesions in the superior or postero-superior position of the acetabular rim on MRI. Only one hip presented a cam impingement explaining these lesions. For the others, such lesions can be explained by repetitive extreme hip flexion and rotation while dancing. Dancers' hip ROM is normal in flexion/extension but internal rotation tends to be lower and external rotation higher than normal, in relation to the turnout position.

FM 71

Sports and recreation activity of patients with femoroacetabular impingement before and after arthroscopic osteoplasty

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Introduction: Hip arthroscopy represents a new and minimal invasive method of treating patients with femoroacetabular impingement (FAI). However, participation in popular sports after this procedure has not yet been analyzed. The purpose of the presented study was to evaluate the rate and level of sports and recreation activity before and after arthroscopic osteoplasty for femoroacetabular impingement.

Methods: 53 patients (41 male, 12 female) were evaluated preoperatively and after a mean follow up of 2,4 years (range: 2–3,2 years) after arthroscopic osteoplasty for cam and mixed FAI. Evaluation included the type and level of sports activities (sports frequency score, SFS) as well as clinical outcome in terms of pain (VAS) and function (nonarthritic hip score, NAHS)

Results: 45 of the 53 patients had regularly participated in popular sports until the first occurrence of FAI symptoms. Preoperatively, only 4 of these 45 patients had maintained their accustomed level of activity while 31 patients had returned to their full accustomed level of activity at the final follow up. None of the patients, who had not been active in sports before the first occurrence of symptoms of FAI (n = 8), had begun participation in sports after arthroscopic osteoplasty. SFS significantly increased from 0,78 to 1,84 and the mean VAS pain score significantly improved from 5,7 to 1,5. NAHS improved from 54,4 to 85,7. There was no significant correlation between SFS and NAHS, as well as between SFS and VAS pain score preoperatively, but a significant correlation was seen at the time of the last postoperative follow up. The 3 most frequent sports activities postoperatively were biking, hiking and fitness.

Conclusion: Arthroscopic osteoplasty can significantly improve the rate and level of popular sports activities in patients with FAI. The level of postoperative sport activity directly correlates with the clinical outcome in terms of pain and function.

FM 72

Arthroscopic therapy of femoroacetabular impingement of the hip – an average 2 years follow-up of 105 cases

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Introduction: Femoroacetabular impingement (FAI) has recently been proved as an important cause of groin pain and limitation of range of motion in young active patients and a possible cause for early osteoarthritis of the hip. Open surgical treatment is currently the standard. We hypothesised that arthroscopic therapy can lead to comparable clinical results with a less invasive procedure and shorter rehabilitation than with open surgery.

Methods: Between 2004–2007 a consecutive cohort of 105 cases (88 patients, m = 60, f = 28) was operated for symptomatic cam- or mixed FAI. All patients were prospectively evaluated for clinical parameters, visual analogue pain score, initial radiological degenerative changes, alpha angle and the Non Arthritic Hip Score Questionnaire (NAHS).

Results: The average follow-up was 2.3 years (range, 1.3–4.1). Pain decreased from 5.5 (range, 0–9) to 1.5 (range, 0–6, $p < 0.001$). Range of motion for internal rotation increased from 4.9 degrees (range, –30–30) preoperatively to 22.9 degrees (range, –5–50; $p < 0.001$) and flexion improved from 110.0 degrees (range, 60–150°) preoperatively to 123.3 degrees (range, 70–150; $p < 0.001$) postoperatively. The alpha-angle diminished from 72.8 degrees (range, 51–110) to 50.3 degrees (range, 34–84). The NAHS improved from 56.7 points (range, 15–92.5) to 84.6 points (range, 47.5–100, $p < 0.001$), showing 75% good and very good results. In 9 patients (8.6% of all patients) a total hip arthroplasty had to be performed.

Conclusion: In conclusion, the results after arthroscopic therapy for femoroacetabular impingement are favorable and comparable to those after open procedures reported in literature. Statistical analysis showed a significant improvement of all outcome measurements.

FM 73

Preliminary, qualitative testing of a flexible video endoscopy system in diagnostic knee and hip arthroscopy

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Introduction: Compared to rigid arthroscopic optics, a flexible camera system offers significant theoretical advantages: It has the potential to adapt to the naturally curved surface of joints, to move within the joint without stress to the cartilage or capsule and thereby to reduce the number of portals needed. Former studies evaluated flexible fiberoptic systems which were insufficient regarding image resolution. This is the first report on new flexible video-endoscopes with the so called “chip-on-the-tip” technology which results in much improved image resolution comparable to the conventional rigid scopes.

Methods: With a plasma sterilized 3.9 diameter flexible video endoscopy system (Visera ENF V, Olympus) commonly used in diagnostic rhino-laryngoscopy, we performed primary testing in two cadaver knee joints. After successful testing of feasibility we performed two qualitative diagnostic knee and five hip arthroscopies in combination with a conventional rigid 30° arthroscope (Storz).

Results: Qualitative testing showed us superior visibility of the posterior aspects of the knee joint as insertion of the posterior medial and lateral meniscal horn, tibial insertion of the posterior cruciate ligament and the posterolateral capsule-ligamentous corner with acceptable image resolution and clarity according to the rigid arthroscope. In the hip, it is possible to go around the femoral neck. There seemed no potential for cartilage damage at all. Difficulties were stated in terms of scope handling, navigation and orientation within the joint as well as potential damage of the videoscope during performance or with repetitive plasma sterilization.

Conclusion: This is to our knowledge the first report on flexible video arthroscopy. Some of the expectations were met, such as to reach virtually every corner the joint without almost any risk for the cartilage or other joint structures with acceptable image quality. However, there are two main unexpected significant disadvantages. First, as the scope does only flex in one direction, the scope has to be rotated according to the angle around which it is moved. Thereby the image horizon on the screen rotates which makes orientation in space very difficult. Second, the scope has no own stiffness and cannot displace soft tissue sideways. Therefore, controlled navigation is very difficult. If these issues can be technically resolved, flexible arthroscopy will be a very viable option particularly for narrow joint spaces

Key Words: Arthroscopy, flexible video endoscopy, knee joint.

FM 74

Intertrochanteric osteotomy for segmental avascular femoral head necrosis – predictors of outcome

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Introduction: Avascular necrosis of the femoral head continues to be a difficult problem to treat surgically. Multiple studies have reported mediocre results with various procedures. Intertrochanteric flexion osteotomy is a common treatment for avascular femoral head necrosis, but the lesion zone is rotated into the weight bearing zone when the hip is flexed. A retrospective review of all proximal femoral osteotomies was performed to evaluate whether direction, location and size of the necrotic lesion affects outcome.

Methods: A selection of 27 hips of 22 patients were included to this study. Mean follow up was 6.5 years (range 2–20 years). Radiographic

analysis was performed with regard to the Ficat classification system, Kerboul angle, Tönnis grade of arthrosis and location of the necrotic area. Clinical outcome was measured concerning the Merle d'Aubigne Index. We differentiated two comparable groups for further analysis (flexion group vs. non-flexion group including extension, varisation and valgisation osteotomy). Long term survivalship was analysed by Kaplan Meier curve with respect to patient's age, gender and genesis of disease.

Results: The two groups were comparable to the number of patients, mean age, allocation of gender and genesis. Except for only Ficat stage III in the flexion group, all lesions were Ficat stage I or II. The Kerboul angle was smaller in the flexion group (average 178.57°) compared to the non-flexion group (180.79°). Earlier Ficat stages were seen in non-flexion group, but follow up was shorter in this group (4.2 yrs vs 8.7 yrs). Failure was defined as proceeding to THR. The non-flexion group had 3 THR at an average of 4.6 years compared to 10 THR at 8.2 years after flexion osteotomy. Clinical outcome in the flexion group was excellent / good in eleven cases compared to nine excellent / good hips in the non-flexion group. Survival analysis showed a mean preservation of the femoral head postoperative in 50% for five years after flexion osteotomy and 55% for six years after non-flexion osteotomy.

Conclusion: The study demonstrates that independent to location, size and direction a mean survival of the femoral head can be achieved for 5 years regardless to direction of osteotomy.

FM 75

Analysis of a new hemostatic and analgetic bioresorbable putty for bone surgery

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Background: Xybrex™ Absorbable Hemostatic Bone Putty is a soft, moldable, biocompatible, absorbable material intended for use in the management of bleeding and pain management from the cut surface of bone (i.e. harvest site of iliac crest bone graft) containing 16% (by weight) lidocaine which is mainly released over a 3–4 days period.

Methods: A pilot study with 14 subjects was conducted to provide initial evidence of the safety and efficacy of Xybrex for hemostasis and the treatment of postoperative pelvic pain following iliac crest bone graft (ICBG) harvest. Subjects (7 each) were assigned to be treated with either Xybrex or similar bone putty (Orthostat) that did not contain lidocaine. Subjects were provided with patient controlled analgesia (PCA) for management of their postoperative pelvic pain for the first 3 days after surgery. Regional nerve blocks were administered for the control of the foot pain. Pain evaluation was monitored every 4 hours post surgery using a 100 mm Visual Analog Scale for the first 72 hours after surgery. Serial blood draws were performed at baseline and at 2, 4, 8, 12, 24, 48, and 72 hours.

Results: The mean size of bone block taken from the iliac crest from the Xybrex subjects was 3.7 ± 2.2 grams vs. 3.4 ± 2.4 grams for the Orthostat subjects ($p = NS$). The mean amount of Xybrex applied to the resulting bone defect in the Xybrex subjects was 4.3 ± 1.2 grams vs. 4.3 ± 0.8 grams for the Orthostat subjects ($p = NS$). Subjects treated with Xybrex showed a significantly improved area under the curve of the VAS score (AUC_{VAS}) pain intensity as compared to Orthostat from 1 to 12 hours (mean AUC_{VAS} 175 vs. 250; $p < 0.05$). The serum levels of lidocaine reached a peak at 4–8 h after application staying at all times well below the level of cardiotoxicity (6 µg/ml). There were no unanticipated serious adverse effects experienced by subjects in the study. There was one seroma in the graft site that required manual expression of the serous fluid to resolve due to overload of Xybrex amount to the site.

Conclusion: Xybrex appears to offer significant analgesic effect in the immediate post-operative period. A larger randomized study is being planned in order to verify the results from this pilot study.

FM 76

Dynamic hip screw (DHS) fixation of extracapsular proximal femur fractures – predictive factors of failure in a series of 567 cases

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Objective: A retrospective radiological review of 567 consecutive cases at Western Australian tertiary hospitals over a 3 year period (2002–2004) was performed.

Methods: The Picture Archive Computer System (PACS), a state-wide computerized radiology network, was used to review radiographs. Female: male ratio was 2.79 to 1. Pertrochanteric fractures

(Orthopaedic Trauma Association 31-A1 and 31-A2) accounted for 95.4% of cases. According to Evan's classification, 418 fractures were stable (73.7%) and 149 unstable (26.3%).

Results: Failure of fixation occurred in 14 cases (2.5%); ten due to hip screw cut out (1.8%) and four due to plate pull off (0.8%). All cases of cut out had a significantly higher mean tip apex distance (TAD) (31 vs 20mm, $P < 0.001$) and an unstable fracture configuration; 8 of 10 had a poor reduction. Bivariate logistical regression revealed TAD of 25 mm or more to be most predictive of cut out; followed by mean TAD, superior anterior and inferior posterior screw placement, unstable fracture configuration and poor reduction. Unassociated factors included gender, age, American Society of Anesthesiologists' score, plate angle and length, operation time and surgeon level. A three-variable model found TAD of 25mm or more and unstable fracture configuration to be predictive of failure, but not poor reduction. Cases with a TAD of 25mm or more with unstable fracture configuration and a poor reduction had a 21.6% chance of cut out (8 of 29).

Conclusion: Compared with other series, our rate of failure is low. The most important predictors of construct failure were found to be variables of screw position and fracture configuration.

Infection rate of percutaneous Iliosacral screw fixation following temporary use of a pelvic C-clamp

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Objective: To report on infectious complications related to the percutaneous fixation of displaced posterior pelvic ring disruptions following primary temporary immobilization using a pelvic C-clamp.
Design: Retrospective analysis of consecutive cases.

Setting: University Trauma Center.

Methods: Between 1993 and 2008, 34 consecutive patients with unstable pelvic ring fractures were treated by urgent temporary stabilization with a pelvic C-Clamp. Of those, 9 (8 men 1 woman) with a mean age of 46 years (range 31 to 58 years) were subsequently treated using a percutaneous sacro-iliac screw fixation (Synthes, Stryker) after a delay averaging 4.4 days (range 1 to 7 days) as part of the final fracture fixation. Screws were inserted either from new stab wounds or from the incisions used for the c-clamp insertion. The incisions for the insertion of the c-clamp were left open in all cases. Pelvic clamp as well as SI screw insertion wounds were screened regularly for any signs of infection.

Results: All surgical wounds (c-clamp insertion incisions) were left open and healed. We observed one superficial wound infection that healed after regular wash-outs. There were no deep infections reaching the SI screws in our series and no SI screws had to be removed before fracture healing.

Conclusion: Conversion of a temporary pelvic ring stabilization to a percutaneous SI joint fixation with screws inserted either through the same or a different incision is a safe considering the risk of local infection.

FM 77

Free communications VIII

Incidence and risk factors of adjacent fractures after Kyphoplasty vs. Vertebroplasty in vertebral compression fractures

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Introduction: The percutaneous cement augmentation (Kyphoplasty and Vertebroplasty) is an efficient procedure to treat the acute and chronic pain in vertebral compression fractures. Both therapies lead to a fast and satisfying anatomic stabilization and pain reduction under a relatively low perioperative risk. However, some patient populations in different studies have shown recurrent vertebral adjacent fractures after an initial successful procedure (e.g. 15.6% in: Risk factors of developing new symptomatic vertebral compression fractures after percutaneous Vertebroplasty in osteoporotic patients Wan Soo Lee Æ et al. European Spine Journal, Volume 15, Number 12 / December 2006). In literature there is good evidence about the efficiency and biomechanical results of both procedures, but not about the incidence and risk factors of adjacent fractures.

Method: In our study we included 178 patients with vertebral compression fractures who were operatively stabilized by Kyphoplasty or Vertebroplasty, during the period of January 2007 to December 2008. We investigated this study to find out more about the incidence and the risk factors for adjacent fractures after percutaneous augmentation, depending on two procedures as described above. Aim of our study is to find out if there is a significant difference between Kyphoplasty and Vertebroplasty regarding adjacent fractures.

Results: Until today we included 65 patients of the year 2007 in a retrospective study. Initially 89 of 96 fractures were treated operatively by percutaneous augmentation. 38 fractures (42.7% of treated fractures) were treated by Kyphoplasty, 51 (57.3% of treated fractures) by Vertebroplasty. The mean age was 73.2 years, 76.9% female, 23.1% male patients. Together, 11 (16.9%) patients suffered by totally 17 adjacent fractures (20.2% of treated fractures). 55.6% of these adjacent fractures were caudal to the initial fracture level localized.

FM 78

Preventive vertebroplasty in osteoporotic patients – early outcomes and analysis of subsequent vertebral fractures

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Type of study: prospective monocenter case-series from 4/2007–3/2008.

Patient population: 226 interventions (1137 augmented levels) in 203 patients with osteoporotic vertebral fractures were analysed 2–6 months postop. There were 77.8% females. Median age was 78 yrs for both sexes.

Intervention: percutaneous vertebroplasty with PMMA. 364 (32%) vertebrae were fractured, 773 levels (68%) were prophylactically cemented.

Outcome parameter: pain alleviation (VAS 0-100), quality of life (QoL) improvement (NASS, EQ-5D), complications and incidence of subsequent vertebral body fractures (VBF) at 2–6 months postop. Evaluation of segmental kyphosis and alignment in patients with 1–3 VBFs. New fracture and reoperation rates at 2 months postop were calculated depending on extent of preventive augmentation (4 groups).

Advantage: pain decreased from 56.7–41.4 pts at the six months followup ($p < 0.0001$). QoL on EQ-5D ($-0.6 - 1$) improved from preop 0.32 pts – 0.58 pts after six months ($p < 0.0001$). The prep Beck-Index (anterior/posterior height) improved from a mean of 0.64–0.8 postop and remained stable after two and six months ($p < 0.0001$). The local sagittal angle improved from 15.8° preop to 9.4° postop, 9.8° after two months and remained stable after six months ($p < 0.0001$). There were cement leakages in 33% of the fractured VBs and in 0.78% of the prophylactically cemented VBs, none of these extrusions caused into radiculopathic symptoms. Total intraoperative complications were seen in 4.4% (9 cases), 8 cases with hypotension and one cement embolism. The reference group 1 with a maximum one prophylactically cemented level had refracture and reoperation rates of 18% at 2 months postop. In contrast, the group 4 with multilevel augmentation above and below the fractured levels had 12% new fractures and 9% reoperations. Group 2 with prophylactic augmentation of the adjacent levels only had rates of 16% and 13%, respectively. Group 3 with multilevel augmentation either above OR below the fractured levels had 23% new fracture or reoperation rates. None of the differences was significant due to an underpowered analysis.

FM 79

FM 80

Complications in surgical treatment of lumbar spinal stenosis (LSS) and their predictors: analysis of 2579 SpineTango patients

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In 2000 the international spine registry SpineTango was created under protectorate of European Spine Society. The following report presents data on complications in surgical treatment of lumbar spinal stenosis in 2579 patients. Between 05.2005 and 12.2008 4006 patients with LSS were documented in the registry. 2579 patients having no additional pathology and at least 1 follow-up were included in the analysis. Additionally to descriptive analysis, multivariate logistic regressions (REGS) were performed to reveal predictors for the respective complication type, and odds ratios (OR) were calculated. As co-variables age, age subgroups, gender, rigid stabilisation, fusion, decompression, dynamic stabilisation, extension of lesion, number of previous surgeries, OP time, segments and access were evaluated in SAS ($\alpha = 0.05$). Mean age of the patients was 67.2 ys (21–97 ys), whereas 49% were females. The rate for surgical complications was 4.9%. The most dominant was dura lesion (60.9%) followed by wound infection (8.0%). The REGS revealed OP time as a single significant co-variable for surgical complications ($p < 0.001$; 2–4 h OP vs <2 h OP OR 2.1; >4 h OP vs <2 h OP OR 4.1). The rate for general complications was 3.1% and the most frequent complications were urinary (31.6%) and cardiovascular (26.3%). According to REGS, the significant co-variables for general complications were age group ($p = 0.012$, patients ≤ 65 ys vs patients > 75 ys OR = 0.4) and fusion ($p < 0.001$, with vs without fusion OR = 3.4). Follow-up complications were seen in 2.4% of patients and most frequent were superficial wound infections (17.2%) and motor disturbances (11.5%). The REGS showed gender ($p = 0.013$, f vs m OR = 0.5), rigid ($p < 0.001$, with vs without stabilisation OR = 3.8) and dynamic stabilisation ($p = 0.045$, with vs without stabilisation OR = 2.7). In summary, surgical complications, namely dura lesions, are the most frequent type of complications in surgical treatment of LSS, and they are influenced by OP time. Gender and fusion are predictors for general complications, and gender, rigid or dynamic stabilisations for follow-up complications. SpineTango proves to be an excellent tool for patient's documentation in spine surgery allowing for detailed statistical analyses.

FM 81

The severity of patient-rated complications after spinal surgery

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Introduction: It is generally accepted that the patient should be the main judge of outcome after spinal surgery, using self-ratings of pain, function, and quality-of-life. Recently, the assessment of complications after surgery was investigated using a similar patient-orientated approach and yielded approx 4-fold the typical complication-rates reported by surgeons themselves. However, the severity of these complications was not assessed, and it was unclear whether they impacted notably on the patient's life. The present study examined the perceived severity of patient-rated postoperative complications.

Methods: All German-speaking lumbar spine patients operated on within our Center from 1.9.2006–31.8.2007 were asked to complete a questionnaire 12 months after surgery (global outcome and satisfaction with treatment of back problem). Patients were also asked: "did any complications arise as a consequence of your operation 1 year ago (e.g. problems with wound healing, paralysis, sensory disturbances, etc.)? If so, give details." They rated the bothersomeness of any such complications on a 5-point adjectival scale.

Results: 863 (91%) patients returned the questionnaire. 31% patients reported complications. Sensory disturbances were most common (38% of all complications), followed by pain (22%), pain and sensory disturbances (11%), motor problems (8%), and wound healing (6%). The distribution of the complications' "bothersomeness" was: 2% not at all, 19% slightly, 27% moderately, 35% very, and 17% extremely bothersome. Bothersomeness showed a significant correlation with global outcome (Rho = 0.51, $p < 0.0001$) and satisfaction (Rho = 0.41, $p < 0.0001$).

Conclusion: The majority of complications reported by the patient are perceived to be moderately to extremely bothersome, and they impact on the global outcome rating and satisfaction of the patient. Hence they are not just inconsequential findings. Just like outcome, "complications" and their severity should be assessed from both the patient's and the surgeon's perspectives. Surgeons' complication-rates are typically much lower than 31%; the reasons for the discrepancy with the patients' perceptions needs further investigation.

FM 82

Surgical outcome studies: is a 2-year follow-up always necessary?

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Introduction: Current recommendations for the publication of studies on spine surgical outcome include the need for a minimum 2-year follow-up. However, it is questionable whether this is always necessary. In order to maximise the availability of data in prospective analyses and registries, it would be of interest to examine how comparable the outcomes are at various follow-up time-points.

Methods: In connection with a quality management system, questionnaire data were obtained pre-operatively and at 3, 12 and 24-months after surgery from all patients operated on for degenerative lumbar diseases between 2005 and 2006. The Core Outcome Measures Index (COMI) and (post-operatively) questions concerning global outcome and satisfaction with treatment were completed.

Results: 789 cases were included. The multidimensional COMI sum-score reduced from 7.8 (SD 1.7) before surgery to 4.3 (SD 2.8) at 3 months, 4.0 (SD 2.9) at 12 months and 4.0 (SD 2.9) at 24 months. On an individual basis, there was a highly significant correlation between the change in COMI score recorded after 3 months and that recorded after either 12 months ($r = 0.65$, $p < 0.0001$) or 24 months ($r = 0.57$, $p < 0.0001$). 87% of those patients reporting a "good" global outcome at 3 months (and 74% of those reporting a "poor" outcome) reported the same at 12 months; the corresponding figures for consistent outcomes at 3 and 24 months were 85% (for good outcome) and 66% (for poor outcome) respectively. Similarly, 92% of those reporting a good outcome at 12 months (and 79% reporting a poor outcome) reported the same at 24 months.

Conclusion: For the majority of patients there was little change in outcome beyond the first follow-up, and in particular between 1 and 2 years. The early results were a good predictor of the longer-term outcome. The indiscriminate insistence on the "minimum 2-year follow-up" criterion should perhaps be reviewed.

FM 83

Benchmarking in the Swiss Spine Registry: results of 43 Dynardi lumbar disc prostheses compared to the pool data

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Purpose: The Swiss Spine Registry (SSR) is the first mandatory registry of its kind in the history of Swiss orthopaedics and follows the principle of "coverage with evidence development". Recently developed and clinically implemented the Dynardi total disc prosthesis (TDP) accounted for 10% of the implanted lumbar TDP in the registry. We aimed at comparison of the Dynardi and Pool data.

Methods: Between March 2005 and January 2009 528 patients with TDP were documented in the registry. 43 patients with 46 Dynardi prostheses operated by two surgeons were compared to 485 patients with 562 other prostheses in the pool. Surgery, implant, 3 month and 1 year follow-up as well as comorbidity, NASS and EQ-5D forms were collected. For statistical evaluation the Wilcoxon signed-rank test was used.

Results: Significant and clinically relevant reduction of back pain and leg pain as well as improvement of quality of life was seen in both groups ($p < 0.001$ postop vs preop). Comparison of Dynardi vs pool data regarding postoperative back and leg pain showed no statistically significant differences. Also comparisons of intraoperative and follow-up complications, revisions, and number of patients who reached a minimum clinically relevant pain alleviation of 18 points in back and leg pain showed no statistically significant differences between the samples. EQ-5D score improved in the Dynardi group from 0.36 preop to 0.86 postop and in the pool from 0.32 to 0.73. This difference between Dynardi and pooled data was significant ($p = 0.003$).

Conclusions: In a short term perspective lumbar total disc arthroplasty appears as a safe and effective procedure regarding pain reduction, improvement of quality of life and complications. The Dynardi prosthesis in comparison to the pool appears to be similar to the pool regarding postoperative back and leg pain as well as regarding complications and revisions. The confirmed significant difference was documented regarding postoperative EQ-5D score. The SSR proves to be an excellent tool for collection of observational data in a nationwide framework as well as for quality control providing users with benchmarking.

FM 84

Minimalinvasive technique of lumbopelvic stabilization prevents postoperative wound disorders after open reduction of posterior pelvic ring

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Introduction: Lumbopelvic distraction spondylodesis with (triangular osteosynthesis) or without additional iliosacral screw allows anatomic reduction of posterior pelvic ring after sacral fractures, correction osteotomies of malunions or septic destruction of iliosacral joint and permits early weight-bearing. However, this technique is complicated by wound necrosis or infection in up to 20–30%. We describe our experience with a more minimalinvasive technique.

Methods: In a series of 8 consecutive patients (January 07–September 08) with severely displaced vertical shear injuries (n = 5), one non-union 2 months after bilateral, one malunion 6 months after unilateral vertical shear injuries and one case after resection of iliosacral joint because of tuberculosis infection the following technique was carried out. After paravertebral skin incision fascia thoracolumbalis was minimally dissected medial and lateral. Multifidus muscle was mobilized without complete distal dissection. In dependence on lumbar anatomy polyaxial low profile pedicle screws were inserted (only L5 (n = 4), L4 and L5 (n = 2) or L3 and L4 (n = 2)). The second or third pedicle screw was placed into the os ilium. After vertical and horizontal reduction connection rod was inserted under the multifidus muscle. In addition, in six cases iliosacral screw for compression was placed percutaneously. In the seven cases with vertical shear instability anterior pelvic ring was fixed further through Stoppa approach.

Results: The mean age of the eight included patients was 45.9 years. In the postoperative course no infection or wound healing disorder were observed. All cases healed without delay. In 5 cases removal of lumbopelvic fixator was carried out 9.6 months after stabilization.

Conclusion: This minimalinvasive technique of lumbopelvic distraction spondylodesis in combination with a polyaxial low profile system prevents postoperative wound disorders.

Short anterior correction in thoracic adolescent idiopathic scoliosis with mini-open thoracotomy: Radiological, clinical and pulmonary function results

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Introduction: Report on the operative technique for correction of thoracic AIS with anterior short fusions. Operation technique, fusion levels, clinical, radiological and pulmonary function results are described.

Methods: Prospective study of 50 adolescent patients (age 15.2 ± 2.5 y) with minimal follow up of 2 y. 7–8 cm mini-thoracotomy was used for approach to instrument the thoracic spine with a single rod titanium implant. 360° discotomies and partial rib head resections were done in the instrumented levels. Clinical and radiological results, pulmonary function and SRS-24 questionnaire were analysed.

FM 85

Free communications IX

FM 87

Impact of radial head micro-anatomy on radial head prosthesis

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Purpose: The aim of this study was to quantify bone micro-architecture within the radial head with high-resolution micro-computed tomography and to show the impact of these results on radial head prosthesis.

Methods: 50 fresh frozen human cadaveric elbows were analysed with a mean age 75 years. The structure of radial bone head was determined by use of pQCT (Slice thickness 82 microns).

Results: There's no difference of between size left and right elbow: no (sd = 1.78). The mean head length is 22.51 mm, the average. Head width is 21.18 mm, the cartilage height is 11.21 mm, the distance articular surface to top bicipital process is 20.74 mm, the angle between articular surface and diaphysis axis is 88.24 degrees. The bone density of the radial head (0.327) is higher than the neck density (0.200). The medial internal area of the head is higher than in the lateral area, this could explain the high number of fractures in this part. We obtained a radial cartography of trabeculae: web of thin trabeculae in the external part of radial head, oblique orientation of thick trabeculae in the internal part of radial head, oval shape of the

Results: The average amount of motion segments fused was 5.5 (4.5 vertebrae). Most distal level fused was T12 in 6, T11 in 27 and T17 patients. The fusion was on average 2.5 (min 1 – max 5) segments shorter than the scoliosis curve (upper to lower end vertebra). The last instrumented vertebra is 1.3 (min 0 – max 3) segments higher than the lower end vertebra of the curve. The instrumented thoracic curves had improved 58% at 6 weeks postoperatively and 56% at 2 year follow-up. Apex vertebra rotation of thoracic curves improved 74%. The non-instrumented lumbar curve improved 34%. Thoracic kyphosis increased 32%. Clinical rib hump improved 45.3%. The preoperative %FVC was average 81%. There was no significant reduction in pulmonary function at 2 y follow up. The patients were satisfied with the clinical and cosmetic results. Result of SRS-24 was 61.4 points preoperatively and 98.6 points at 2 y.

Conclusion: Motion segments are saved through this technique. Cobb angle correction is somewhat less in comparison to posterior fixation techniques. Good clinical, radiological results and good patient's satisfaction were achieved. The lung capacity is not compromised.

FM 86

Implant removal after posterior stabilization of the thoraco-lumbar spine

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Objective: Implant removal because of pain after posterior lumbar fusion is a widely performed operation. We conducted a retrospective study to examine whether patients benefit from implant removal.

Patients and methods: 58 patients (30 male, 28 female, mean age 46.5 y) having undergone removal of pedicle screws because of pain and discomfort were interviewed 6–24 months postoperative. Fracture was the initial diagnosis in 41% of the patients and degenerative spine disease in 58%. Evaluated were: patient satisfaction and outcome after the operation, patients' native language and psychological background, operative data, hospital stay and complications.

Results: Pain decreased significantly from 6.2 to 4.8 on VAS postoperatively. Complications occurred in 5 patients (8.6%). 36 patients (62%) stated they had some benefit from the operation, but only 7 patients (12%) were free of pain completely. 37 patients (64%) would undergo the same procedure again. Outcome in the subgroup of foreigners was significantly worse, though the psychological background did not affect the outcome. Preoperative diagnostic infiltration was helpful in 9 of 13 patients.

Conclusion: Removal of pedicle screws because of back pain is effective, but only in 12% of patients complete remission of symptoms can be achieved. However, 64% of patients would undergo the same procedure again. Preoperative diagnostic infiltration can help to predict the outcome but results are inconsistent. Different social backgrounds with language difficulties may worsen the outcome. Surgeons should consider these results when planning implant removal and patients should be informed thoroughly to avoid too high expectations.

medullar without any trabecula. The medullar cavity looks curved and oblique. All these information lead us to understand why do radial prosthesis have problems: Size mismatch, radial head sizes tend to run very larger, stem size choice are too far from the native canals, camming at the radiocapitellar joint and proximal head, not enough depth of the fovea.

Conclusions: Anatomic structures are very important for radial head prosthesis and a new concept would be created.

FM 88

Revascularization of the humeral head by a pedicled acromion bone graft. An anatomical investigation about technical feasibility

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Background: Avascular necrosis of the humeral head is the second most common site for osteonecrosis in the human body. Aside from fracture, most cases of osteonecrosis are either idiopathic or follow corticosteroid administration. The treatment of avascular necrosis of the humeral head depends on the stage of the disease as well as the dimension and location of the necrosis. Generally, the outcome is poor

and complete restoration of the shoulder function is hardly ever attained. Contrary to osteonecrosis of carpal bones were vascularized bone grafts routinely are performed since decades, reports of such procedures at the humeral head are only anecdotic.

Objective: To investigate the technical feasibility of harvesting a vascularized bone graft from the acromion, to assess the length and the variability of its pedicle, and to examine its range of transposition to the humeral head.

Methods: Pilot dissections were performed on Thiel-fixed specimens, after arterial casting with Polyurethane. A standard deltopectoral approach was used. The thoracoacromial trunk was identified, followed through its acromial branch, until its ramifications entered the anterior aspect of the acromion. A volume of bone was harvested, a little larger but similar to an acromioplasty, still attached to the coracoacromial ligament and to the vascular pedicle. After deadline for abstract submission, it is planned to report over twenty dissections in ten embalmed specimens, with the primary focus on the variability of the branches of the thoracoacromial trunk, the constancy of a distinct acromial branch, its dimensions and potential use as nutrient vessel for a pedicled acromion bone graft.

Results: On pilot dissections the pedicle could consistently be followed to the acromion, its mean length was 9.6 cm. The range of transposition was mainly limited by the length of the coracoacromial ligament, which acts as a protector. However, the distance was far sufficient to allow a tension free transfer of a vascularized bone graft to the humeral head. Results of further dissections will be reported.

Conclusion: With this study we demonstrate the surgical feasibility of a vascularised bone graft from the acromion, pedicled on the acromial branch of the thoracoacromial artery. This technique may have the potential to be a new joint-preserving procedure for osteonecrosis of the humeral head. However, its clinical usefulness needs to be further examined.

FM 89

Resistance training with elastic bands: possibility to provide a specific treatment protocol?

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Introduction: Elastic band type Theraband[®] is commonly used in our institution to instruct home exercises. We actually use the band grade to increase intensity of the training without a precise rehabilitation protocol. A numeric scale could facilitate the structure and communication of rehabilitation aims and procedures. At our best knowledge no study checked the resistance of elastic band type Theraband[®] to use it in a clinical setting. Thus we aimed to investigate the amount of strength patients use while doing exercises with such an elastic band. Our specific aims were: a) define the force needed per grade of elastic band when it is stretched with a specific length from various initial lengths; b) compare those values with those indicated by Theraband[®] and c) evaluate if the initial length influence the amount of force needed to stretch it.

Methods: We tested 5 different band grades of the Type Theraband^{®1} (yellow, red, blue, grey, grey dark). Each Theraband[®] was fixed on a specific apparatus which was linked to a computer. We tested all elastic bands with an initial length of 30, 40, 50, 60 and 80 cm. We prolonged the initial length 30, 40 and 50 cm with 5, 10, 15, 20, 25 and 30 cm and the initial length of 60, 70 and 80 cm with 10, 20, 30, 40 cm. The apparatus was calibrated every time prior to test a new Theraband[®].

Results: The results showed a logarithmic progression between the different band grades. The values were quite similar to those described on the brochure of the producer, except for the 2 highest grades of the bands. Of particular and clinical relevance, the initial length of the Theraband[®] seems to influence the strength a patient has to use for realizing his exercises.

Conclusions: We have to be conscious of advantages and limitations of such elastic bands. Theraband[®] play an important role in training sessions, however one must be aware of its limitation for precise rehabilitation protocols for example with patients who have a strength limitation. Access to an online table with an overview about strength related to band grade and elongation could facilitate therapeutic decision making.

1 Rehatrain, C. Schmid et U. Geiger 2000 Théraband marque déposée fournie par la maison Simon Keller: 8 couleurs.

FM 90

Influence of retroversion of the humeral component on the lever arm of the teres minor muscle in reverse total shoulder arthroplasty

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Introduction: External rotation weakness remains a major problem of patients treated with a reverse total shoulder prosthesis. In most of these patients the supra- and infraspinatus tendons are torn and active external rotation completely depends on the integrity of the teres minor muscle. The purpose of this study was therefore to find out whether changing the retroversion of the humeral component could increase the external rotation moment arm of the teres minor muscle and therefore improve the external rotation strength of the reconstructed shoulder.

Methods: Six embalmed cadaver shoulders were tested. The soft tissues were removed and the teres minor muscle was replaced by a metallic wire representing the muscle's action line. The tendon travel method was used to determine the lever arm of the teres minor muscle during a rotational movement from 45° of internal rotation to 90° of external rotation with the arm in 30° and 60° of abduction in the scapular plane. Each specimen was tested with the joint intact, and after insertion of a reverse total shoulder prosthesis with the humeral component successively fixed in 30° of retroversion, neutral version, and 30° of anteversion.

Findings: In the intact joints, the lever arm of the teres minor muscle increased from 13 mm in 45° of internal rotation to 22 mm in 90° of external rotation. Insertion of a reverse prosthesis with 30° of retroversion did not significantly change these values. However, decreasing the retroversion of the prosthesis to neutral version and 30° of anteversion increased the lever arm by an average of 4.1 mm and 9.5 mm, corresponding to a relative improvement of 25% and 86% in internal rotation and 22% and 35% in external rotation.

Conclusions: The version of the humeral component of a reverse shoulder prosthesis influences the external rotation moment arm of the teres minor muscle and therefore the external rotation strength of the reconstructed shoulder. Neutral version and anteversion are biomechanically superior to retroversion.

FM 91

Towards an intraoperative engineering of osteogenic grafts from the stromal vascular fraction of human adipose tissue

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Background and objectives: Mesenchymal and endothelial lineage cells isolated from the stromal vascular fraction (SVF) of human adipose tissue have proven osteogenic and vasculogenic capacity in vivo when seeded and expanded inside 3D hydroxyapatite scaffolds in a perfusion system for five days. However, compliance and practicability in the clinical field might be hampered by the requirement of a GMP-facility and the need for two surgical procedures. This study evaluates the feasibility of an intraoperative approach to engineer cell-based bone grafts with tissue harvest, cell-isolation, cell-seeding in the scaffold and subsequent implantation within a few hours.

Methods: SVF cells were isolated from lipoaspirates and excised fat samples of 4 healthy donors by enzymatic digestion. 1–2 mm silicated calcium-phosphate granules (Actifuse[®], Apatech) were mixed with A) 1x10⁶ or B) 4x10⁶ fibrin embedded nucleated SVF-cells with or without addition of 250 ng BMP-2. Cell-fibrin-scaffold-constructs were immediately implanted ectopically in nude mice for eight weeks. In parallel, cells were analysed by cytofluorimetry and assessment of clonogenicity. Upon explantation, constructs were processed histologically.

Results: Clonogenicity of the freshly isolated SVF and subsequently implanted cells was 13% ± 3.1% resulting in a density of 2.12x10⁶ ± 0.6x10⁶ (A) and 12.2x10⁶ (B) CFU-f/ml. Mesenchymal markers and endothelial markers were expressed. After eight weeks of implantation, we observed dense matrix but no true bone tissue with and without addition of BMP-2 in condition (A). In condition (B), typical bone tissue with compact collagen matrix containing osteocytes could be observed only when BMP-2 has been added. In situ hybridisation for human specific ALU sequences confirmed that the osteocytes and lining osteoblasts were human cells and thus originated from the implanted SVF cells.

Conclusions: To our knowledge, this is the first report providing preliminary evidences and proof-of-principle that intraoperative engineering of autologous cell-based bone graft substitutes could be achieved by mixing adipose tissue stromal cells embedded in a fibrin matrix with ceramic-based scaffolds. Further studies will determine whether the engineered constructs, implanted in a relevant orthotopic model, would be able to induce *de novo* formation of bone tissue also in the absence of BMP.

FM 92

Humeral head retorsion in normal and osteoarthritic shouldersR. W. Nyffeler¹, A. Terrier², M. Schober¹¹Orthopädische Klinik, Inselspital, Bern; ²Laboratory of Biomechanical Orthopedics, Ecole Polytechnique Fédérale de Lausanne

Introduction: The aetiology of primary osteoarthritis of the shoulder is not known. Badet and co-workers analyzed the CT-scans of a small group of patients with severe osteoarthritis and found a decreased retorsion angle of the arthritic shoulders (8 degrees). However, osteoarthritis related changes of the humeral head made their measurements difficult and the authors could not draw any conclusions. The purpose of our study was therefore to measure the retorsion of a big number of humeri with mild to moderate degenerative changes and to compare the results to specimens without osteoarthritis.

Methods: Three hundred and fourteen dry humeri were provided by the Natural History Museum of Basel and the Institute of Anatomy of Köln. There were 175 left and 139 right humeri and 59 pairs. 117 specimens (37%) had osteoarthritic changes (73 grade 1, 26 grade 2, 18 grade 3) according to the scoring system of Samilson Prieto. The specimens were fixed in a frame with the humeral shaft axis oriented vertically. A 3D MicroScribe digitizer was used to determine the anatomical neck and the tangent to the anterior articular surface of the distal humerus. A nonlinear least-squares algorithm was used in order to determine the best fitting plane of the anatomical neck. The retorsion angle of the humeral head was determined with use of a vector analysis.

Findings: Retorsion averaged 27.6 degrees (range 0 to 54) in the specimens without osteoarthritis and 32.6 degrees (range 0–64) in the specimens with degenerative changes. This difference was not statistically significant. In the pairs of humeri the difference of retorsion between both sides averaged 7.8 degrees (range 0–23). Eleven pairs had degenerative changes on both sides and in six pairs osteoarthritis was present only on one side. Retorsion was not correlated with age or sex.

Conclusions: Osteoarthritis of the shoulder is not associated with abnormal retorsion of the humerus. The high percentage of degenerative changes on both sides of paired humeri may be a sign that genetic factors play a role in the development of osteoarthritis.

FM 93

Recombinant FGF-18 with a collagen II binding domain prevents cartilage degeneration in mice over five weeks after two intra-articular injectionsDominique A. Rothenfluh, Mikael Martino, Jeffrey Hubbell
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Introduction: Lesions or defects of articular cartilage do not heal spontaneously and therefore lead to osteoarthritis. FGF-18, a natural growth factor, has been shown to stimulate matrix production and thus cartilage regeneration in a rat model. Because of the short half-life of the growth factor and because of its limited availability in the cartilage matrix, growth factors and protein therapeutics have only little activity in cartilage. We have thus engineered a variant of FGF-18 with a collagen II binding domain which binds to the cartilage matrix and is released to the cells over time.

Methods: Standard molecular cloning techniques were used to make a bacterial expression vector. FGF-18 proteins were expressed in *E. coli* and purified using heparin affinity chromatography. Collagen II binding properties were probed using surface plasmon resonance. The purified proteins were then injected in the knees in an instability model in mice at surgery and 2 weeks later. Mice were sacrificed after 5 weeks and histological sections obtained and scored.

Results: Surface plasmon resonance showed a 1000-fold slower release from collagen II of variant FGF-18 compared to its wild type. After 5 weeks and only two injections, mice treated with the variant FGF-18 showed intact articular cartilage, whereas mice treated with wild-type FGF-18 showed an irregular articular surface and complete proteoglycan loss, the control animals exhibited complete destruction of the articular surfaces in the unstable knee.

Conclusion: Variant FGF-18 prevented cartilage degeneration after only two injections in knee joint instability in mice. In comparison, the wild-type protein has too short a half-life and was therefore not able to prevent cartilage degeneration. Engineered variants of growth factors with matrix binding properties appear to be viable therapeutics in the future to treat cartilage degeneration with only few intra-articular injections.

FM 94

Anterior crucial ligament rupture – Healing through intraligamentary dynamic stabilisation, a sheep studyS. Kohl^{1,2}, H. Kohlhof¹, A. Krueger¹, M. Hartel¹, C. Roeder¹, B. Gasser², S. Eggli¹¹Klinik für Orthopädische Chirurgie, Universität Bern; ²Dr. h. c. Robert Mathys Stiftung, Bettlach

Introduction: The predominant opinion in treatment of the injured anterior cruciate ligament (ACL) is that the rupture does not heal and therefore the ligament has to be replaced by a graft. The authors of this study hypothesize, that the major cause for absent healing of the ligament consists in the relative knee instability, disturbing the initiation of ligament healing. The aim of this study is to evaluate the healing capacity of ACL rupture following primary repair with intraligamentary dynamic stabilization.

Methods: The ACL was cut close to the femoral insertion in 14 sheep. The contralateral not operated side served as the control group. An intraligamentary wire was drilled from the tibial side, in the longitudinal direction of the ACL to the lateral outside femur. A 10 mm spring centre screw is implanted in the tibia, which applies a tension of 120 Newton on the wire and holding the knee in a posterior drawer. Additional measures to initiate the healing were femoral microfracturing (11 of 14) and covering the ruptured ligament with a collagen tissue (7 of 14). Histological evaluation, magnetic resonance imaging (MRI) and biomechanical testing were performed after 3 months (7 sheep), 6 months (5 sheep) and 9 months (2 sheep).

Results: After 3 days, all animals showed none lameness and used the operated leg with full weight bearing. Investigation at 3-6-9 months showed a macroscopical healing in all 14 specimens. The histological and MRI examination confirmed the healing response of the ACL after intraligamentary dynamic stabilisation. Positive correlation with the healing reaction showed a perfect isometric positioning of the stabilization device, femoral microfracturing and use of a collagen cover sheet. Biomechanical testing showed an average increase of 2.4 mm (range 0 mm–4.5 mm) of the anterior drawer compared to the nonoperated control group.

Conclusion: It could be shown, that a ruptured ACL has the biological potential to heal after intraligamentary dynamic stabilization of the knee in a sheep model. Encouraged by these results the authors will implement this technique in a clinical setting.

FM 95

Primary stability testing of novel refixation strategies in case of a proximal humeral four-part fractureD. Baumgartner¹, R. Mathys², B. Gasser², E. Stüssi¹¹Institute for Biomechanics, ETH Zurich; ²RMS Foundation, Bettlach

Introduction: Proximal humeral fracture refixation in case of hemiarthroplasty is often accompanied by fragment displacement and subsequent bone resorption. It has been shown that Greater Tuberosity (GT) union to the humeral shaft reveals a better clinical outcome than non-union. The aim of the investigation was therefore an optimisation of the refixation technique with respect to a reduced fragment migration.

Method: Three different refixation techniques using titanium cables were compared: A) circumferential wire placement by two parallel slings interconnecting GT and Lesser Tuberosity (LT); B) cable placement similar to technique A) with additional cable supporting pins and C) cables oriented collinear to the longitudinal axis of the humerus; connecting GT and LT to the shaft. A standardised four-part fracture model according to the literature was implemented in artificial humeral bone models (last-a-foam®, FR 6715); Affinis Fracture® prosthesis was implanted. Migration between GT-shaft, LT-shaft and LT-GT was detected by a 3-D camera system (Breuckmann GmbH). An experimental shoulder machine simulated active rotator cuff muscle forces of m. supraspinatus, m. infraspinatus, m. subscapularis and middle part of the m. deltoideus. Glenohumeral joint movement up to an abduction angle of 75° was performed. This refers to thoracohumeral abduction of around 150°. 20 loading cycles were applied.

Results: GT-to-shaft migration was significantly reduced for C) in comparison to A) and B). No significance was observed between A) and B) for all measured parameters.

Migration@20cycl.	A) two slings	B) two slings + pin	C) collinear to shaft
GT-to-shaft [mm]	0.8 ± 0.1	0.7 ± 0.3	0.16 ± 0.1
LT-to-shaft [mm]	0.5 ± 0.4	1.1 ± 0.6	0.3 ± 0.2

Tab. 1: Interfragmentary distances after testing the different techniques.

Conclusion: A stiff cable system which is placed collinear to the muscular loading direction for abduction reduces fragment migration. Cable supporting pins do not show any negative effect on the primary stability in comparison to a direct cable-to-bone contact. Nevertheless, a reduction of the line-pressure may reveal a positive effect on the biological healing process and thus preventing avascular necrosis.

FM 96

Functional and radiological outcome 10 to 20 years after ankle ORIF

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Introduction: Ankle fracture represents the most frequent osseous injury in both the elderly and non-elderly population. To date, only a limited number of retrospective studies have addressed outcome following ankle Open Reduction and Internal Fixation (ORIF). The purpose of this study was to assess functional outcome and satisfaction 10 to 20 years after operative treatment of ankle fractures and to evaluate the incidence of ankle osteoarthritis (OA).

Methods: We designed a retrospective study including all consecutive patients who underwent ankle ORIF between January 1988 and December 1997 in a University Hospital setting. Pilon and talus fracture as well as pediatric patients were excluded. Patients were seen by two senior residents 10–20 years after their index surgery. Residual pain was measured using the Visual Analog pain Scale. Function and satisfaction were assessed using the Olerud and Molander Ankle Score, the SF-12, and the American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score. Ankle OA was scored according to the revised Kellgren and Lawrence (K&L) scale.

Results: 375 patients (159 women, 216 men) underwent ankle surgery during the defined period. To this point 75 of them have been evaluated. The mean age at the time of operation was 42.9 years (± 17.1 ; range 16–86), the mean duration follow up was 17.3 years (± 3.3). Preliminary results indicated that in more than 80% of the cases, patients reported no residual pain. OA assessment was limited to K&L grade 2 in over 85% of patients.

Conclusion: Preliminary results show a trend towards good functional and radiological outcome after ankle ORIF. Definitive analysis is pending.

FM 97

Reliability of conventional ankle osteoarthritis assessment and contribution of a new digital analysis software

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Introduction: Inter-observer variability of osteoarthritis (OA) assessment by the most widely used method, conventional radiology, is a long standing recognized problem. Only selected joints have been studied though, based on frequency of affection and number of therapeutic options at disposal. The ankle in this context was not accurately addressed until now. Evolution and innovations in the treatments of ankle OA in the last years now require development of reliable and comparable staging systems. In this context, we evaluated inter-observer variability of ankle OA assessment using conventional radiology and compared it to results obtained using a new ankle image digital analysis (AIDA) software.

Methods: AP ankle radiographs were collected in the course of a retrospective study measuring functional and radiological outcome 10 to 20 years after ankle Open Reduction and Internal Fixation (ORIF). OA was assessed by two senior residents and two foot and ankle surgeons. Scores were attributed according to the revised Kellgren and Lawrence (K&L) scale. Recorded parameters also included tibial and talar sclerosis as well as time needed for staging. Inter-observer variability of K&L scores and sclerosis assessment was established by an epidemiology specialist. Finally, results were compared to objective measurement of joint space width and bone sclerosis obtained using a new digital image analysis software.

Results: Preliminary results in 75 patients indicated that complete inter-observer agreement in K&L scores is obtained in only 20% of cases, mean deviation in the 5 level scale (0 to 4) was 1.25. Analysis of the correlation with digital measurements is pending.

Conclusion: Preliminary results show moderate inter-observer agreement in ankle OA assessment by mean of the commonly used K&L scale. Publication of an atlas of ankle OA radiographs, as done in other joints, is presented as a tool for standardisation of further studies. Digital analysis yielding quantitative values appears as an alternative tool allowing reliable comparative studies.

FM 98

Surgical technique using a medial column screw for complex Charcot midfoot reconstruction

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Neuropathic (Charcot) arthropathy is a well recognized condition that most commonly affects the tarsometatarsal and tarsal joints of patients with diabetic neuropathy. Failure of nonsurgical treatment may

lead to a rocker-bottom foot with recurrent or persistent plantar ulceration. The surgical options are very demanding and need meticulous planning and cautious technique. We report a surgical technique with the use of a medial column screw for surgical realignment and arthrodesis of diabetic neuropathic foot deformities. **Method:** From July 2001 through July 2005 we operated upon 15 consecutive diabetic patients with severe neuropathic midfoot deformities, consisting of a collapsed plantar arch with rocker-bottom foot. Thirteen of fifteen patients presented with a non-healing midfoot plantar ulcer. All were treated surgically with realignment and arthrodesis with a medial column screw, as described by our technique. Some required additional fixation techniques depending upon extension of the deformity. The average age of the patients was 55 years and the mean duration of preoperative evaluation, two years. **Results:** The mean clinical follow-up was 42 months (range, 2 to 6 years). Fourteen patients were able to ambulate and there were no recurrent plantar ulcers. Thirteen patients were able to accommodate custom extra-depth, wide-toed diabetic shoes with molded inserts. One patient required the use of a Charcot-retaining orthotic walker for balance purposes. One patient without prior ulceration developed a deep infection that necessitated an amputation. Four feet developed a nonunion, one of which was symptomatic requiring revision surgery to obtain union.

Conclusion: Surgical reconstruction of a collapsed neuropathic foot is technically demanding but a successful outcome results in an ambulatory patient with a plantigrade foot, free of ulceration and abnormal pressure points. The procedure has an acceptable degree of complication while allowing restoration of function.

FM 99

The effect of Ankle Collateral Ligaments release on Dorsiflexion Stiffness: an Anatomical study

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Joint stiffness in dorsiflexion impedes on normal walking and is a difficult condition to treat. It is a problem frequently encountered after ankle injuries as well as ankle surgeries such as fracture fixation or arthroplasty. The release of extra-articular structures (Achilles tendon and gastrocnemius) is a standard procedure in addressing this problem, but the surgical outcome sometimes proves to be insufficient. The release of intra-articular structures responsible for limiting ankle dorsiflexion (the posterior portion of the deltoid ligament – PDL – and the posterior talo-fibular ligament – PTF) has been suggested, but little is currently available in the literature on the matter. In addition, the question remains which of those two ligaments should be severed. The purpose of this anatomical study is to assert and quantify the effect of ankle collateral ligament release as a mean to increase the dorsiflexion in a stiff ankle. We dissected 16 talo-crural joints on fresh adult cadavers, isolating the PDL and the PTF. We measured on the dissected samples the dorsiflexion of the talo-crural joint at controlled torques, using an electronic goniometer coupled with an electronic dynamometer. We then separated the specimen in two groups: in group A we severed the PDL, and in group B we severed the PTF. The joint mobility in dorsiflexion was then evaluated in the two groups. Results showed a significant difference ($p < 0.0003$) between the two groups. The specimen in Group A gained a mean value of 7.45° in dorsiflexion after procedure, whilst group B benefited from an increase only averaging 3.45°. Additionally, we measured the joint movement after releasing both ligaments. The incremental gain resulting from this combined procedure was not statistically significant ($p = 0.88$). Based on these results, we recommend, in treating ankle stiffness in dorsiflexion, and after insufficient results of the routinely carried out procedures, the isolated and careful release of the PDL.

FM 100

Tantalum for ankle and hindfoot reconstruction

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Introduction: A structural graft is often needed to fill gaps during reconstructive procedures of the ankle and hindfoot. Autograft, the current gold standard, is limited and associated with donor site morbidity in up to 48%, while the alternative allograft carries risks of disease transmission and collapse. Therefore trabecular metal (Tantalum) with a healing rate similar to autograft, high stability and no donor site morbidity has been recently used in surgery of the hip, knee and spine. However its use has not yet been documented in foot and ankle surgery.

Methods: From 6/2006 to 11/2006 nine complex foot and ankle arthrodeses were performed using a Tantalum spacer and the patients

were followed up over a 2-year period. Bone ingrowth into the Tantalum was analyzed with Micro-CT in 3 suitable patients.

Results: All arthrodeses were fused clinically and radiologically after 3–4 months and no complications occurred. AOFAS-score increased from 32 to 74. The Micro-CT demonstrated bony trabeculae growing onto the Tantalum.

Conclusion: Tantalum thus proved to be a valuable and safe structural graft option for ankle- and hindfoot arthrodesis, exhibiting excellent fusion rate and stability, no donor site morbidity and a greater efficiency in the operating room than autograft.

FM 101

Functional significance of first metatarso-phalangeal joint arthrodesis

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Introduction: Indications for arthrodesis of the first metatarso-phalangeal joint (MTP1) are commonly arthrosis (hallux rigidus), rheumatoid arthritis, failed hallux valgus surgery, severe hallux valgus, infectious arthritis, fractures and neuroarthropathies. Many reports focus on technical and radiological issues but few studies emphasize the functional outcome considering daily activities, sports and expectation of the patient.

Method: We retrospectively reviewed the patients who underwent MTP1-arthrodesis from 2002 to 2005 in our institution. Clinical and radiological results were assessed but we specially focussed on the functional outcome. Scoring systems used were the SF-12, EQ-5D, PASI, FFI and AOFAS (10 points given to MTP1 mobility) scales.

Results: 61 of 64 consecutive patients were evaluated. Female to male ratio was 49:15, mean age at surgery was 67 years, the average follow up was 29 month. Even if radiological consolidation was incomplete in 18 patients, all patients had a clinically stable and rigid arthrodesis. Mean AOFAS score was 87 (24–100) points at follow up. The FFI was 5.91% (0–66%). Patient satisfaction was excellent in 37 patients (60%), good in 18 (30%), fair in 5(8%) and poor in 1 (2%). EQ-5D was 0.7 (0.4–1). 40 patients (66%) estimated their cosmetic result as excellent, 15 (25%) as good, 4(6%) as fair and 2 (3%) as poor. 10 patients (16%) had no shoe wear limitation, 48 (79%) had to wear comfortable shoes and 3 (5%) needed orthopaedic wearing. Professionally 34 patients (56%) had better performances, 18 (26%) had no change and 9 (18%) had aggravation of their capacities but this was due to other health reasons. In sports, 16 patients (26%) had better performances, 35 patients (57%) no change and 10 (17%) were worse as consequence of other health problems for 7. Finally, 56 patients (92%) would recommend the operation and 5 (8%) would not. **Conclusion:** Experience of clinical practice suggests that the idea of fusing the first MTP joint is initially frequently disregarded by the patients because they fear to be limited by a rigid forefoot. Our results show, in fact, that this procedure can be proposed for numerous pathological situations with the perspective of good to excellent outcome in terms of function and quality of life in the majority of cases.

FM 102

Total ankle replacement with the mobility implant: Clinical and radiographic results of 238 consecutive prostheses

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Introduction: Total ankle arthroplasty (TAA) evolved over the past decades. High failure rates and discouraging outcomes of first-generation implants severely restricted their use, but also led to the development of modern three-component implants, such as the Mobility total ankle replacement system. This study prospectively analyzed the clinical and radiographic results of the first 238 cases using the Mobility implant.

Methods: Between November 2003 and October 2007 we performed 238 primary TAAs in 231 patients (117 women) with a mean age of 62 ± 13 years (24 to 86 years). Diagnoses were posttraumatic ankle OA in 121 ankles, primary ankle OA in 74 ankles, rheumatoid arthritis in 36 ankles, and hemochromatosis in 7 ankles. All patients were prospectively followed-up yearly. All intraoperative and postoperative complications, revisions and failures were noted. Clinical outcomes were assessed using a visual analogue scale (VAS) for pain and the AOFAS hindfoot score. Radiographs were studied for component positions, the presence of radiolucencies, cysts and osteophytes, and for any evidence of loosening. The range of motion (ROM) was assessed on function x-rays.

Results: Complete follow-up data were available for 226 ankles (95%). The mean follow-up time was 2.9 ± 15 months (12 to 60 months). Four ankles failed (1.8%). Intraoperative complications occurred in 9 (3.8%) and postoperative complications in 19 ankles (8.4%). Surgical revisions were performed in 18 cases (8%). The VAS pain significantly improved from 7.7 ± 1.5 preoperatively to 1.7 ± 1.9 at last follow-up. AOFAS scores significantly improved from 48.2 ± 17.5 to 83.5 ± 14.0. Thirty-six percent of the ankles had a varus or valgus deformity preoperatively, a residual postoperative ankle malalignment was observed in 9 ankles (4%). Tibial radiolucencies were detected in 29% of the implants, talar lucencies were seen in 2.2%. Periprosthetic cysts occurred in 11 ankles (4.9%), mainly in the malleoli. None of the components appeared to be loose. Ankle flexion and extension significantly improved after surgery, the total ankle ROM improved from 19.9 ± 9.3° to 22.5 ± 8.4° (p < 0.001).

Conclusion: The short-term results of TAA using the Mobility implant are satisfactory. In particular the failure rate of 1.8% at 2.5 years after surgery is encouraging. Longer-term follow-up studies have to confirm the present findings.

FM 103

Using step activity monitoring to assess ambulatory activity before and after total ankle arthroplasty

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Introduction: The aim of this study is to compare the walking activity of a cohort of individuals before and after total ankle arthroplasty (TAA).

Methods: Nineteen consecutive patients (ten males and nine females) with mean age of 58.72, selected for TAA between January and June 2006, were prospectively reviewed with the use of a dedicated ambulatory activity-monitoring device to assess their natural ambulatory activity. Patients were tested in the community for two weeks duration, one month prior to and at least eighteen months after surgery. The ambulatory parameters were assessed through measurement of the number of steps at different cadence, and the time spent walking at different walking paces. Data were analyzed by using specific statistical methods.

Results: This study revealed a significant improvement in the number of steps walked at normal cadence (b = 331.63, p = .00) and significantly reduced at low cadence (b = -402.52, p = .00) and medium cadence (b = -386.29, p = .00), before and after TAA. However, there are no significant different between two phases of assessment in term of time spent walking.

Conclusion: These quantitative data allow a clear comparative assessment of walking ability following TAR and demonstrates that this intervention improves patient's walking pace.

FM 104

Primary subtalar arthrodesis for Sander Type IV calcaneus fractures

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Introduction: Sander type IV intra-articular calcaneus fractures remain a real challenge in traumatology practice. In most cases, evolution's subtalar joint is severe and rapid arthritis.

Methods: Between 2005 and 2009, 12 patients underwent primary subtalar arthrodesis associated with open reduction and internal fixation at the same surgical time in our Département. We analysed radiologically postoperative complications, bony consolidation time, anatomic axes and height of the hindfoot. Clinical evaluation was based on AOFAS score.

Results: No wound complication (necrosis/infection) was occurred. Radiologically bony consolidation was observed in all patients between 3 and 6 months postoperative. Two varus and 1 excessive valgus malunions were noticed. AOFAS score is under evaluation.

Conclusion: On the base of these preliminary study's results, primary subtalar arthrodesis seems a good therapeutical option in cases of these difficult fractures. Nevertheless, it's about a delicate intervention where attention has to be taken as far as it concerns the position of hindfoot in the frontal plane.

Mesuring femoral anteversion using 3d reconstruction

FM 105

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Rotational malalignment of the femur is a common problem after shaft fracture osteosynthesis. Preoperative planning is essential to restore a physiological anteversion and the reliability of the measure highly depends on the radiological technique chosen. 2D CTscan is at present the standard tool to measure the angle between the femoral neck and the condyles' posterior edge. The imprecision of this technique depends on the choice of the CTscan slices. We present a simple and fast technique using 3D reconstruction of standard CTscan exams.

Method: A group of 11 patients presenting clinical signs of femoral malrotation has benefited of a standard CTscan. Those exams were presented to 4 operators who calculated the anteversion of both femora using the standard 2D technique as well as the 3D reconstruction. Time needed, results and accuracy of both methods were examined.

Results: The mean time needed for both femora mesures was 81.6 seconds (SD 21.2) for the 2D method and 78.4 seconds (SD 21.5) for the 3D method. The anteversions of the femora measured with both techniques have similar results (SD of 15.5 for 2D and 15.4 for 3D, $p = 0.590$). There was no significative difference between observers ($p = 0.719$).

Conclusion: The 3D reconstruction method is an efficient and fast technique for femoral neck anteversion mesures. The increasing availability of 3D reconstruction softwares may allow frequent use of this reproducible technique and will lead to many applications in preoperative planning and diagnostic procedures.

The Equidistant Method – An accurate algorithm for diagnosis of Femoroacetabular Impingement (FAI)

FM 106

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Introduction: We present an impingement detection application based on the equidistant method and compare it to three other methods. We propose that this approach will be more accurate in detecting impingement zones than previously presented interference detection applications.

Material and methods: Four different hip joint simulation methods were implemented to detect FAI: a *simple* method, a *constrained* method, a *translated* method and our newly developed *equidistant* method, which continuously maintains a constant joint space by superposing approximated best fitting acetabular and femoral spheres. Five remodeled sawbone pelvis and 10 sawbone femurs were used. Using a tracked hand-held laser scanner 3D models of these sawbones were generated. Subsequently, three fresh frozen pelvis (six hip joints) were used. A CT scan of the specimens was obtained and 3D models were created. Specimens were then affixed to a table-based screw clamp. After registration and restricted surface matching, anatomically relevant hip motions were performed and tracked by a NDI Optotrak Camera. As soon as the examiner visualized impingement, the exact location was digitized with a tracked pointer. For the plastic hip joints five, and for the cadaver specimens ten anterior and five posterior impingement conflicts were digitized and repeated five times. DRB transformations were converted and applied to the four methods. Possible impingement areas were determined. The following measurements were then computed and analyzed.

Results: The equidistant method showed significantly higher accuracy in [mm]-distances and rotational angles in the magnitude of all assessed parameters for detection of anterior and posterior FAI.

Discussion: The equidistant method for detecting anterior and posterior impingement has shown to be superior to the other methods investigated. In each of the tested parameters using sawbones and in three of four assessed parameters in the cadaver trials there was a significant difference detected. This method has the potential to build the foundation for a reliable set of diagnostic and therapeutic planning tools for assessment of FAI.

Performance of femoral head-neck osteochondroplasty using a navigated milling device

FM 107

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Introduction: We developed a planning and navigation application for impingement relief using surgical reaming devices and hypothesized that our application will enable the surgeon to accurately perform an osteochondroplasty with a navigated reaming device according to a distinct preoperative plan.

Material and methods: Nine identical plastic bones with a distinct cam impingement were scanned with a tracked handheld laser scanner and subsequently 3D computer models were generated. These were transferred to our previously implemented FAI Planning application and a virtual osteochondroplasty for cam impingement with creation of a sufficient femoral head-neck junction was performed. The planned 3D model was then transferred to our developed FAI Navigation software. As a navigated reaming device, a manually calibrated Electric Pen Drive was equipped with a dynamic reference base (DRB) and could then be tracked by a Polaris camera system. A second DRB was attached to the proximal femur which was subsequently registered against the 3D model. Afterwards, an orthopaedic surgeon performed a navigated osteochondroplasty guided by the on-screen information of the FAI Navigation software. Three different plans were navigated three times using the identically shaped bones. After the procedure, the reshaped plastic bones were scanned with the 3D handheld laser scanner again and could be registered and compared as gold-standard to the planned, as well as the virtually reamed models.

Results: All measured mean distances between the actually reamed surfaces and the planned, as well as the computed and visualized surfaces were less than 1 mm in every bone, with standard deviations less than 0.6 mm.

Discussion: Our study revealed that navigating a reaming device for osteochondroplasty of the proximal femur according to a preoperative plan, can be achieved with good accuracy. Our application bears a great potential as a basis for arthroscopic or mini-open approaches to these pathomorphologies.

Effect of tibial tray inclination on the femoro-tibial contact pattern of a mobile total knee arthroplasty

FM 108

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Introduction: The posterior inclination of the tibial component is an important factor that can affect the success of total knee arthroplasty. It can reduce the posterior impingement and thus increase the range of flexion, but it may also induce instability in flexion, anterior impingement between the polyethylene of postero-stabilizing knee prosthesis, and anterior conflict with the cortical bone and the stem. Although the problem is identified, there is still a debate on the ideal inclination angle and the surgical technique to avoid an excessive posterior inclination. The aim of this study was to predict the effect of a posterior inclination of the tibial component on the contact pattern on the tibial insert, using a numerical musculoskeletal model of the knee joint.

Methods: A 3D finite element model of the knee joint was developed to simulate an active and loaded squat movement after total knee arthroplasty. Flexion was actively controlled by the quadriceps muscle and muscle activations were estimated from EMG data and were synchronized by a feedback algorithm. Two inclinations of the tibial tray were considered: a posterior inclination of 0° or 10°. During the entire range of flexion, the following quantities were calculated: the tibio-femoral and patello-femoral contact force, and the contact pattern on polyethylene insert. The antero-posterior displacement of the contact pattern was also measured. Abaqus 6.7 was used for all analyses.

Results: The tibio-femoral and patello-femoral contact forces increased during flexion and reached respectively 4 and 7 BW (bodyweight) at 90° of flexion. They were slightly affected by the inclination of the tibial tray. Without posterior inclination, the contact pattern on the tibial insert remained centered. The contact pressure was lower than 5 MPa below 60° of flexion, but exceeded 20 MPa at 90° of flexion. The posterior inclination displaced the contact point posteriorly by 2 to 4 mm.

Conclusion: The inclination of the tibial tray displaced the contact pattern towards the posterior border of the tibial insert. However, even for 10° of inclination, the contact center remained far from the posterior border (12 mm). There was no instability predicted for this movement.

From paper drawing to the computer assisted preoperative simulation of osteosynthesis

FM 109

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Computer assisted planning in a routine orthopedic surgery is well established. Trauma surgery is always different because specially the reduction of a fracture is a 3D process. We present a new software

solution for preoperative planning of osteosynthesis as a result of collaboration between an implant manufacturer and an IT/imaging company. A referenced and digitalized x-ray image is imported into the application from a PACS. In the following segmentation process all the key fragments will be marked. In a simulated reduction the fragments can be rotated and moved the way to restore the correct form of the broken bone. From the manufacturers implant catalog the desired implant can be chosen. The implant is already included with its 3D data. So it is possible to show the implant in a 3D form. In the last step the correct implant size, position and screw length are determined. Optionally distance or angle measurements can be imported. A final planning report includes the drawing and a complete list of the planned implants due to the manufacturers catalog. The new software has three major advantages: First the young colleagues are forced to think about the fracture patterns. So the software acts as an instruction tool. Second the final report improves the communication with your OR-Team. Desired implants can be prepared more precisely. And finally the drawing helps you in your preoperative information of the patient. The software is easy to handle with high accuracy. Planned implants match with reality. The fact that all implants are already included with 3D data opens the door for the future: a complete 3D planning of osteosynthesis. Indeed there is still a long way to go. Specially the problem to acquire a 3D data of the bone without CT-scan and the 3D segmentation and reduction still are unsolved problems. But there are already some approaches to overcome these hurdles.

Biomechanical considerations in plate osteosynthesis: the effect of plate-to-bone compression with and without angular screw stability

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Objective: We compared the biomechanical stability of bone-plate constructs using a compression plate (CP), an internal fixator (IF), and a combination plate (CP/IF).

Methods: Standardized simulated shaft fractures with a segmental defect in composite bones (n = 60) and intraarticular distal femur fractures with a comminuted supracondylar zone in fresh frozen cadaveric femurs (n = 36) were stabilized by CP, IF, and CP/IF. Construct stiffness, plastic deformation, and fixation strength were measured under axial compression and torsion using a biaxial testing machine.

Results: The experimental results indicate for the distal femur fracture model that IF has less loss of reduction by plastic deformation under axial load compared to CP (IF 61% of CP). Under torsion, the CP showed significantly (P < 0.05) decreased plastic deformation compared to the IF (CP 51% of IF). The combination (CP/IF) of the 2 fixation principles generally resulted in a higher load to failure under axial compression and torsion (145% failure load of CP and 118% of IF under axial compression, 88% of CP and 109% of IF under torsion). Results were similar between the 2 fracture models.

Conclusions: Under compression, IF provides similar fixation in comminuted fractures and was better than the CP for avoiding loss of reduction, whereas under torsional loading, CP was more important for stiffness, plastic deformation, and load to failure than IF. However, combination (CP/IF) fixation seems advisable in intraarticular and extraarticular fractures of long bones with a metaphyseal comminution. These data may be utilized by surgeons to build a more specific treatment plan in patients with these fracture types.

FM 110

Long-term release of VEGF promotes vascularization and osseointegration of CaP ceramics *in vivo*

FM 111

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Background: Angiogenesis is supposed to be a key contributor to the healing process following implantation of bone substitute materials. Calcium phosphate (CaP) ceramics are without intrinsic angiogenic activity. Researchers have tried to render the materials angiogenic through addition of growth factors such as vascular endothelial growth factor (VEGF). Using a co-precipitation technique we have previously achieved a sustained delivery of bioactive BMP-2 from CaP ceramics *in vitro*. It was now hypothesized that a long-term release of VEGF may induce angiogenesis and bone formation *in vivo*.

Methods: VEGF (1 µg/ml and 5 µg/ml) was adsorbed and co-precipitated onto CaP ceramics. ELISA was used to analyze protein release kinetics *in vitro* over 19 days. For *in vivo* experiments BCP

ceramics were implanted into a cranial window preparation in Balb/c mice (n = 36). Angiogenesis and microvascularization were investigated over 28 days by intravital microscopy. Bone formation was quantified histomorphometrically.

Results: Co-precipitation decreased the initial release of VEGF (first 24 h) as compared to adsorption (350 ± 10 ng vs. 627 ± 28 ng, p < 0.05). A sustained cell-mediated release of co-precipitated VEGF was induced by osteoclasts (37 ± 4 ng/72 h). *In vivo*, adsorbed VEGF did not promote angiogenesis and bone formation. Co-precipitated VEGF stimulated angiogenesis in a dose-dependent manner and enhanced bone formation significantly at a concentration of 5 µg/ml.

Conclusion: Our *in vivo* findings demonstrate that local administration of VEGF with an appropriate delivery system can improve vascularization and osseointegration of CaP ceramics. In this regard, the release kinetics is crucial for the efficacy of VEGF delivery. Long-term release of VEGF, achieved with the co-precipitation technique enhanced angiogenesis and bone formation *in vivo*. In contrast, short-term release VEGF with superficial adsorption did not improve the investigated parameters.

	Negative control Adsorption	Adsorption (VEGF 1µg/ml)	Adsorption (VEGF 5µg/ml)	Negative control Co-precipitation	Co-precipitation (VEGF 1µg/ml)	Co-precipitation (VEGF 5µg/ml)
FCD (mm/mm ²)	4.7 ± 1.0	5.9 ± 0.9	5.9 ± 0.7	4.0 ± 0.7	6.6 ± 1.2*	8.4 ± 0.8**
V _{bone} (mm ³)	0.16 ± 0.02	0.12 ± 0.02	0.15 ± 0.01	0.16 ± 0.02	0.13 ± 0.03	0.21 ± 0.05**
BIC (%)	19.7 ± 6.2	21.4 ± 7.1	22.1 ± 6.6	12.8 ± 5.1	21.3 ± 7.9	36.4 ± 9.5**

FCD: Functional capillary density; V_{bone}: Volume of newly formed bone; BIC: Bone-interface-contact

ANOVA, *p<0.05 vs. negative control, **p<0.05 vs. Adsorption (VEGF 1µg/ml), #p<0.05 vs. Adsorption (VEGF 5µg/ml)

I. S. S. and sugar: Survival scale

FM 112

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Purpose: Improve survival rates of patients with multiple injuries have increased general interest in the quality of polytrauma management. Due to the complex nature of multiples injuries, we think that a special and simple score is needed to evaluate the morbidity of polytraumatized patients. Our purpose was to observe the polytrauma population and to correlate lesions with initial blood sugar concentration. Then we try to make a tight relation between I.S.S. and blood sugar level.

Material and methods: We had prospectively studied 204 patients polytraumatized between January 2006 and December 2007. This data base is in conformity with the ethics comity We had selected the

patient according admission code "polytrauma" with N.A.C.A (National Committee on Aeronautics Score System) score equal or superior to 4. Polytraumatized patient is a patient with several lesions with two or more potentially threatening life. The most important criteria is the mechanism of the trauma : high velocity and height of fall. All patients were checked in the emergency room according A.T.L.S. evaluation. Blood analyse was performed as soon as the patient arrive either in arterial or venous sample. For each one we compare Injury Score Severity (I.S.S.) blood sugar level.

Results: The curve ISS and Glycaemia appears with a linear relation between the two values, especially for blood sugar concentration less than 8. Big variations at the beginning of the curve for value of sugar less than 7 are all due to patients with severe lesions but stable physiologic status and no life threatening. Abdominal injuries always increase the level of blood sugar. Simple limb trauma or spine fracture didn't impair glycaemia except when associated with open wound

fractures, compression syndrome or paraplegia. Average glycaemia of pelvic trauma is 9, 0 and average I.S.S. is 41. Head injury associated with abdominal or thoracic trauma always enhances glycaemia when there are life threatening lesions associated. There isn't any correlation between I.S.S. and age or sex.

Conclusions: Glucose determination in emergency is an *indirect* method of measuring the metabolic response to trauma. High glucose levels may indicate a *significant injury not detected* by physical examination, especially in young population. High blood sugar means soft tissue lesions.

FM 113

Expression of neuropilins and vascular endothelial growth factor and its receptors in human and dog osteosarcoma

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Introduction: Osteosarcoma (OSA) is the most common primary bone tumor in humans and dog and has in both species high metastatic potential¹. Dogs develop OSA spontaneously and are therefore of high interest in investigating the biomolecular similarities in tumor development. Neuropilins (NRPs) are multifunctional, non-tyrosine kinase receptors for vascular endothelial growth factor (VEGF). NRP and VEGF-Receptor (VEGFR) expression is upregulated in multiple human tumor types and correlates with tumor progression and prognosis. In dogs only minimal information on NRP expression is available^{2,3}. The purpose of this study was to determine and compare the expression of NRP 1+2, VEGF and VEGFR1+2 in human and dog OSA.

Methods: We studied the expression of NRP 1+2, VEGF and VEGFR 1+2 on mRNA- and protein-level in the human OSA cell line systems MG63 (-wt, -M6, -M8), HuO9 (-wt, -H3, -M112, -M132) and HOS (HOS, MNNG, 143B). The same parameters were examined on mRNA-level by RT-PCR in 21 dog OSA samples and at the protein level in 7 lysates of dog OSA cells in primary culture with the Western Blot technique.

Results: NRP1+2 encoding mRNA was detected in all human OSA cell line systems and in almost all dog samples. Western blot analysis in human and dog samples indicated abundant expression of NRP1. NRP2 remained undetectable. Expression of VEGF and VEGFR-1, but not of VEGFR-2, was shown on RNA and protein level in the human cell line systems. A similar expression pattern was observable in dog samples.

Conclusion: The expression patterns of NRP1+2, VEGFR-1+2 and VEGF in human OSA cell line systems and in dog OSA tissue samples are comparable. This observation strengthens the assumption that dog OSA share biomolecular characteristics with human OSA concerning tumor development and progression. It underlines the fact that the dog is a valuable animal model to study OSA pathophysiology and for the development of novel treatment strategies.

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FM 114

A new way of quantifying dominant upper-limb mobility in healthy and painful shoulders

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Introduction: Quantification of daily upper-limb activity is determinant in the evaluation of shoulder surgery. For a number of shoulder diseases, problems in performing daily activities have been expressed in terms of upper-limb usage. Although many instruments measure upper-limb movements, there is no accepted standard or widely used objective measure and no device to differentiate left or right shoulder usage. We present an objective method to measure the mobility and quantify the usage of dominant and healthy or painful shoulder movement during daily life.

Methods: 12 patients with unilateral pathological shoulder (rotator cuff disease) are compared to 18 control subjects (10 right and 8 left handed). Both SST and DASH questionnaires were completed by each one. Three inertial miniature modules including triaxial gyroscopes and accelerometers were fixed on the dorsal side of both humerus, and on the thorax. An ambulatory datalogger have recorded the signals during one day.

Results: We observed that right handed healthy subjects used 18% and 26% more their dominant shoulder during respectively stand and sit postures while left handed subjects used 8% and 18% more their left side. In walking periods, shoulder mobility was quite alike for both sides. Patients affected on their dominant arm (PD group) mostly used their non-dominant side (respectively 5% and 9% during stand and sit). For the patients affected on their non-dominant shoulder (PND group), this difference is respectively 28% and 26%. Moreover, we can note that, during walking periods, a difference can be observed (on the contrary to controls). Patients used 13% and 15% more their non-pathologic side respectively for PD and PND groups.

Conclusion: Inertial sensors, during long-term ambulatory monitoring of upper limbs, can quantify the difference between dominant and non-dominant sides. Patients used more their non affected shoulder during daily life. For the PD group, the difference with control can be shown during walking. These results are very encouraging for future evaluation of patients with shoulder injuries since it can provide an objective evaluation of the shoulder mobility and of the treatment outcome during daily life.

FM 115

Telemedicine and wrist fractures

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Introduction: Orthopaedic surgeons are often asked to evaluate x-rays of patients admitted to the A&E Department with the suspicion of a wrist fracture or, in case of an evident fracture, to decide the correct treatment. The aim of this study was to evaluate the feasibility of correctly interpreting the images of injured wrists on the screen of a last-generation mobile phone, in order to evaluate if the specialist could make the right diagnosis and choose the correct treatment.

Methods: Five orthopaedic and one hand surgeons have evaluated the x-rays of 74 patients who sustained an injury to their wrist. In case of fracture they were asked to classify it according to the AO and Mayo classification. The evaluation of the images was accomplished through the PACS available in all the computers of our hospital and, at a different time, using a mobile phone. In order to check the inter- and intra-observer reliability, the same pattern was followed after a few months.

Results: The mobile phones showed a good sensibility in detecting a fracture with moderate specificity. In order to evaluate the possible application of this device in common practice, we also calculated the inter- and intra-observer reliability.

Conclusion: The present paper describes our findings and confirms that the last generation mobile phones can already be used in our clinical practice.

FM 116

Longterm outcome after proximal femoral fracture – are Cooper's data still valid?

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Problem: Patient's outcome following proximal femoral fractures is of increasing importance due to the demographic change. The data published by Cooper in 1997 were based on US studies and are looked upon the reference: one year mortality was found to exceed 30%. One year after the fracture more than 40% were not able to walk independently. We hypothesized that elderly patients who suffered from a proximal femoral fracture and who were treated within the Swiss' healthcare system achieve better outcomes than those reported by Cooper.

Method: All patients who were treated for a proximal femoral fracture in our hospital in between 06/2007 – 05/2008 were prospectively included. Demographic data and mobility status prior to the fracture

were documented. These data were reevaluated one year postoperatively by means of telephone interview.

Results: One year follow up was due for 114 patients so far. Within this group the average age is 83.3 ± 7.3 years. 23 (20%) of these patients had died, 5 patients are lost to follow up. Therefore, follow up could be completed for 86 patients. Mobility status was found as follows:

Mobility	No walking aid	Cane	Walking frame	Not mobile	Unknown
Before fracture	35%	19%	28%	2%	16%
1 year postop	15%	29%	44%	12%	0%

Conclusions: The small number of patients who were "Lost to follow up" documents superior quality of data acquisition. Objective outcome parameters allow reliable interpretation of our results even though the data are preliminary and even though family doctors or relatives had to be interviewed instead of the patients themselves in some cases. Even if all patients who are lost to follow up were rated "dead", our 1 year mortality were less than Cooper's. The outcomes found within this study are even better compared to Cooper's results when looking at patients mobility 1 year postoperatively. Future studies will now investigate, if further improvement is possible with therapy algorithms that are specifically designed for geriatric fracture patients. Our data will serve as baseline data for these studies to come!

FM 117

The impact of infected total hip arthroplasties on hospital costs

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Background: Infection following total hip arthroplasty (THA) is a major complication and a substantial burden for the patient and for health care services. The aim of this study was to quantify and compare the total direct costs for a primary THA, a revision THA for aseptic loosening, and the surgical treatment of an infected THA.

Setting: University hospital orthopaedics department.

Methods: Clinical and financial data were obtained for 14 consecutive patients treated for an infection following THA between 2004 and 2007. Some underwent débridement with partial exchange of the implants, while others had débridement with implant removal followed by delayed exchange arthroplasty (Group 1). Similar data were collected during the same time-period for 12 consecutive patients who underwent revision for aseptic loosening (Group 2), and for 21 consecutive patients who underwent a primary hip arthroplasty (Group 3). Data on resource utilization included length of hospital stay, number of hospitalisations, number of surgical procedures, total number of days spent in the hospital and total inpatient hospital costs. Clinical data were collected from the hospital medical records and our institution's registry of THAs. Economic data concerning actual hospital costs were obtained from the hospital's financial department.

Results: The average cost was CHF 18,829 (range 14,329; 24,739) for a primary THA, 25,877 (range 16,167; 43,419) for revision for aseptic loosening, and 74,130 (range 26,769; 139,519) for revision due to infection. The total direct medical costs associated with revision THA for infection (Group 1) were 2.8 times higher than the direct medical costs associated with revision THA for aseptic loosening (Group 2), and 3.9 times higher than the direct medical costs associated with primary THA (Group 3). The total number of hospital days for group 1 was 4.4 times higher than the total number of days for groups 2 and 3. The number of hospitalisations and operations were 2.4 and 2.6 times higher, respectively, in group 1 compared to groups 2 and 3 because of multiple interventions following infection.

Conclusion: Revision for infection after THA was associated with higher average total hospital costs, total number of hospital days, total number of hospitalisations and total number of interventions. The wide range of costs in group 3 is due to the different treatment options.

FM 118

"Clinic Ltd." – an alternative business model to the one-man practice and affiliated doctor system

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Introduction: The running of an orthopedic practice combined with a position as affiliated doctor in a private hospital is becoming more and more difficult as the pressure of rising costs and the simultaneous reduction of tariffs grows. The risk of the necessary start-up capital, the hurdles of the accreditation moratorium and the unclear future role of affiliated doctors under the DRG system all deter younger colleagues from setting up a private practice after completing their specialist degrees.

Method: From June 2006 five one-man practices joined together spatially and administratively as "Clinic Ltd." at a private hospital. Three young colleagues joined as employees with a stipulated possibility of

later partnership. In addition a consultant joined the group. A transparent allocation of patients by specialist competence was implemented.

Results: After two years one practice partner left due to his age and was replaced by a younger colleague. Two further colleagues were employed to broaden the spectrum of specialist treatment. The financial business analysis shows that the turnover already covered costs after one year. The distribution of operations by expertise and the admission of two additional colleagues lead not only to an increase in the volume of patients but also to an increase in the number of cases of each surgeon in their specialist area.

Conclusion: The "Clinic Ltd." form of organization has successfully proved itself both with regard to starting a professional career and to organizing practice duties. The economic and operational management rests in the hands of doctors. Purposeful employee expansion and a transparent internal distribution of patients supports sub-specialization, which thus enhances the competence to cover the whole allocation spectrum.

FM 119

Strength measurement as outcome parameter for patients undergoing shoulder arthroplasty. Spring balance or Isobex?

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Introduction: Measuring the abduction strength is a well accepted part for the objective assessment of treatment success in shoulder orthopedics. Besides measuring maximal strength with a spring balance, experts recommend the measurement of strength endurance with an electronic device like Isobex™. However, it remains unclear if and to which extent both types of strength measurements correlate in the settings of daily practice. The target of our study was to determine this correlation and to find out whether one or at least three repetitions for the endurance measurements are required.

Material/methods: Patients with an indication for shoulder arthroplasty were measured on both arms before and at defined follow-ups after surgery. This included the collection of the maximum abduction strength with a spring balance and three measurements of the endurance strength with an Isobex™ device. From the latter ones the mean and maximum values were calculated and compared to the spring balance. Additionally, the time point was identified when the maximum value was measured. Patients with abduction below 90° and incomplete records were excluded from the analysis.

Results: In total, 1275 records met the inclusion criteria and were available for the analysis. The mean value of the spring balance measurements was 5.1 ± 2.8 kg. This value was slightly but significantly ($\alpha < 0.0001$) higher as the one of the Isobex™ measurements with 4.5 ± 2.6 kg. The medium variance of the Isobex™ measurements was computed with 0.48 kg, nearly reaching the measuring accuracy of the spring balance of 0.5 kg. The maximum value of the three Isobex™ measurements was already identified at the first measurement in 43.4% of the cases. A significant correlation was found between the Isobex™ and the spring balance measurements ($r^2 = 0.82$, $p < 0.0001$).

Conclusion: The high correlation of both measuring methods indicates the physiological relation of both strength types. With an explained variance of 82% the precision of the spring balance measurements seems sufficient for the daily use in clinical settings when compared to the Isobex™ measurements. Measuring the strength endurance can provide additional information for certain issues, but this needs a repetition of three times to eliminate measuring inaccuracies.

FM 120

Three years experience with measurement of symptoms and disabilities

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Introduction: Symptoms and disabilities can be routinely measured with a simple patient questionnaire. The completed questionnaire yields a patient profile comparable to a clinical x-ray. This permits objective patient selection and management of outcomes. The use of a patient questionnaire to routinely assess symptoms and disability is new, and we report on our experience here.

Patients and methods: Included were all patients at a regional orthopaedic clinic who had completed a patient questionnaire in 2006–2008. The means and medians of 10 measured symptoms and 13 disabilities were calculated. The assessments of 4 orthopedic surgeons and the secretariat were collated.

Results: Between January 2006 and December 2008, 1880 questionnaires were administered to 1148 patients. The most marked symptoms (maximum score 100) were exertion pain (mean 59.4,

median 75), restricted movement (50.7, 50), weakness (38.0, 50), rest pain (37.7, 25), and night pain (36.3, 25). The most marked disability scores were during standing (37.6, 25), working at or above shoulder height (36.0, 25), walking (34.9, 25), sleeping (33.7, 25), and social participation (32.1, 25). Questionnaire completion rate was markedly improved by putting a "Post-It" stick-on instructions for completion on the questionnaire, and posting the questionnaire to the patient's home. The questionnaire markedly simplified patient selection for the physician, because patients with «inadequate» symptoms were easy to identify during consultation.

Discussion: This method is time-consuming in everyday use. The advantages are (1) it increases patients' awareness of their condition, and (2) the patient profile is useful in diagnosis and patient selection. **Conclusions:** Symptoms and disabilities can be simply assessed with the questionnaire, independent of disease. Patient selection can thus be improved (objectified). Completion of the questionnaire is supported by providing instructions.

FM 121

Cross-cultural adaptation and validation of the Foot Function Index for use in German-speaking patients with foot complaints

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Introduction: The Foot Function Index (FFI) is one of the most frequently used self-report questionnaires for patients undergoing foot and ankle surgery. This measure has been validated and translated into several different languages, however, no German version of the FFI exists and to our knowledge, there is even no other German self-report questionnaire for the assessment of patients with foot complaints available. The purpose of this study was therefore to cross-culturally adapt and validate the FFI for use in German-speaking patients with foot complaints.

Methods: The FFI was adapted for the German language according to the recommended forward/backward translation protocol. The following metric properties were assessed in 53 consecutive patients (mean age, 57.2 years; 39 women) undergoing foot or ankle surgery at our department: feasibility, reliability (intraclass correlation coefficient (2,1), ICC), internal consistency (Cronbach's alpha, CA), and construct validity (correlation with the Short Form (SF)-36, a visual analogue scale (VAS) assessing pain, a VAS assessing function, and the University of California at Los Angeles (UCLA) activity scale).

Results: The German FFI (FFI-D) comprised 18 items separated into a pain and a disability subscale. Completion of the FFI-D was feasible. The reliability and the internal consistency were both excellent with an ICC of 0.98 and a CA of 0.97 for the total score. We found moderate to high correlations between the FFI-D and the physical related SF-36 domains ($r = -0.43$ to -0.80), the VAS pain ($r = 0.81$), the VAS function ($r = 0.77$), and the UCLA ($r = -0.52$). Correlation coefficients between the FFI-D and the mental health related SF-36 domains were significantly lower ($r = -0.08$ to -0.32 ; $p < 0.01$), indicating divergent validity.

Conclusion: The German version of the FFI (FFI-D) is a reliable and valid questionnaire for the self-assessment of pain and disability in German-speaking patients with foot complaints.

FM 122

Implementation of the survival focussed trauma register TARN® into a Swiss tertiary care emergency department – methodological considerations and preliminary results of the first 50 cases

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Introduction: Injury is a major challenge for health care services as it is the most common cause of death in the young. Diagnostic and therapeutic approaches to trauma patients are, depending on experience, equipment and different therapeutic doctrines, subject to wide variations. The ability to compare trauma centres among each other using a standardized trauma register helps to reveal unresolved systemic and methodical issues and simplifies thus the quality management in an emergency department receiving major trauma cases.

Methods: In a first step an international trauma register was chosen, applicable for a level one trauma centre. Next, a team responsible for the register management was built within the emergency department. Minor systems adjustments were necessary in order to gather all the information needed for complete assessment in the register. Patient's data of the first fifty patients were entered into the online submission system between October 2008 and January 2009.

Results: The TARN®-Register, primarily common in the UK and Ireland, was chosen. The German trauma database seems too extensive. The US patient population features a higher proportion of penetrating trauma. In contrast, UK's and Ireland's emergency medicine system was found to be the best comparable with the one in Switzerland. Different than other only mortality oriented systems, the TARN® database is capable of predicting the probability of survival of patients. One study coordinate, two medical doctors, one doctorate, two study nurses, one systems administrator is maintaining the register. Data about vital signs as well as clinical, radiological, lab test findings and performed therapeutic measures were collected from the pre-clinical phase, the ED, the ICU and OR, the regular wards and subsequently entered into the online submission system.

Conclusions: The TARN® register could be identified as an appropriate solution for a level one trauma centre. Staff and systems requirements were arranged in order to regularly maintain a reliable data acquisition for the register. The institutions' needs of constantly optimising health care services to trauma patients are met. Results of the first 50 patients (e.g. time to CT, time to OT, survival) will be presented and contrasted to already published data and to the results of other centres connected to TARN.

Posters

P 1

Case Report: Missed stress fracture of the femoral neck in a recreational runner with secondary dislocation

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Introduction: Stress fractures of the femoral neck in marathon runners have been reported. We present the case of a missed stress fracture of the femoral neck with secondary dislocation in a recreational runner.

Case report: At the age of 47 our patient started recreational running, increasing training to up to 25 to 30 km per week within one year. In total he had run over 1000 km when he first felt pain in the region of the greater trochanter of his right hip and the right groin. Due to this, training was reduced before participating in a half marathon. At 11 km he felt a sudden pain in the right groin. 600 m later even walking was impossible. Two days later he still couldn't bear weight. This was diagnosed as a muscle strain or rupture. No imaging was performed, he was put on crutches. 4 weeks later his left crutch slipped away and he fully loaded his right leg which immediately gave strong pain to the right hip. The visible malrotation of the right foot alerted the patient and he finally went to a hospital. The x-ray showed a displaced femoral neck stress fracture. Closed reduction and internal fixation with a 135° Dynamic Hip Screw was done. Postoperatively partial weight bearing was recommended. At 6 weeks the patient was asymptomatic with maintained correct position of the fracture and fixation.

Discussion: Femoral neck stress fractures have been reported in marathon runners or military recruits with increased training intensity. The missed or delayed diagnosis often leads to fracture displacement which increases the number of complications such as osteonecrosis of the femoral head, delayed union, non-union and refracture. Therefore it is essential to take stress fractures of the femoral head into the differential diagnosis of groin pain even in recreational runners as our case demonstrates.

P 2

Spontaneous bone union of a peri-prosthetic femoral neck fracture after implantation of a Durom-Cup

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Introduction: one of the most common complications encountered after hip resurfacing is the postoperative peri-prosthetic fracture of the femoral neck due to avascular necrosis of the femoral head and neck. We describe a case of spontaneous bone union in a peri-prosthetic neck fracture of a patient at our clinic.

Case report: on 10-04-2008, a 58-year-old female patient suffering from primary osteoarthritis of the right hip joint underwent hip resurfacing with a Durom-Cup. Six weeks after surgery she developed acute pain in the right hip and radiographs revealed a peri-prosthetic neck fracture with minimal varus tilting. She received a conservative,

non-weight bearing therapy with an assistive device. Six months after surgery, radiographs proved spontaneous bone union and remodelling of the fracture. Today she is pain free, has excellent joint function, and her Harris-Hip-Score is 100 points.

Discussion: literature supplies a small number of reports on conservative treatment of peri-prosthetic neck fractures after hip resurfacing. There is one case report from Turnbridge, England giving an account of spontaneous bone union in a 60-year-old woman patient receiving conservative treatment for a peri-prosthetic neck fracture following hip resurfacing.

Conclusion: before considering revision surgery, a period of conservative management in patients with a minimally dislocated peri-prosthetic femoral neck fracture after hip resurfacing seems well justified.

P 3

Intraarticular osteochondroma of the hip – an extremely rare condition

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Introduction: Osteochondromas represent the most common benign bone tumor and are distributed randomly asymmetrically at metaphyseal sites of long bones. They never occur in epiphyses. Therefore intraarticular localisation is extremely rare and are only possible at the end of flat bones. The purpose of this presentation is to report a case of acetabular osteochondroma.

Case report: In a 15-year old girl suffering from unilateral hip pain loose bodies in the joint were detected radiologically. The hip was surgically dislocated and pieces of loose cartilage were removed. Histologically no chondromatosis could be proven. Radiologic evaluation performed because of pain recurrence after two asymptomatic years showed subluxation of the hip due to a bony tumor in the acetabular fossa. Again a surgical dislocation of the hip was performed and the lesion removed. Histologically an osteochondroma was diagnosed. The clinical course was uneventful and radiographic follow-up showed no evidence of recurrence during the follow-up of 9 years.

Conclusion: Intraarticular localisation of osteochondroma is a condition that is normally only found in Trevor's disease. In the hip joint a true osteochondroma can occur at the acetabular side and should be considered as a differential diagnosis for the findings of joint pain, bony tumor and decentering of the femoral head.

P 4

Acute neck fracture of the modular Metha Short Hip Stem System. The first case in Switzerland

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Case report: In August 2006, in a by then 38 year old gentleman, a modular short hip stem system (Metha[®] Stem, Plasmacup SC[®], ceramic liner Biolox[®] head; Aesculap Orthopaedics BBraun), was implanted. The postoperative evolution was favorable. The patient was pain free and asymptomatic. In January 2009 during ADL, a sudden crack was heard followed by the inability to walk. X-rays showed a breakage of the modular neck part, at the junction of the stem. A revision surgery (Gibson approach, trochanteric osteotomy) with explantation of remaining prosthesis and subsequent insertion of a cemented stem was performed. In Germany more than 70 cases of this serious complication with that particular implant are known. A potential explanation might lie in the material properties of the titanium alloy. In December 2006 a recall of Aesculap Orthopaedics for the Metha Short Hip System was announced and the material underwent significant improvement and is now composed of a cobalt-chromium forged alloy (IsodurF[®] CoCr29Mo). It is not known, in how many patients this deficient prosthesis has been implanted in Switzerland.

Conclusion: A complete Swiss implant register could identify potential candidates for this disastrous complication thus potentially reducing the risk of serious side effects. It is of utmost importance to inform orthopedic surgeons and patients alike of this deficient implant.

P 5

Recreation of the femoral offset in total hip replacement. A comparison of two different stem systems

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Introduction: The recreation of the anatomical femoral offset is very important in total hip arthroplasty. The femoral offset is the distance between the rotation center of the femoral head and the centerline of the femurshaft. As work arm it is important for the tensions and power that take effect at the implant. If the change of the femoral offset is too excessive it can lead to muscular imbalance and mechanical stem

loosening. We compared two different types of uncemented stems with reference to the recreation of the planned femoral offset (CLS-Spotorno-Stem, Zimmer and Proxy-Plus-Stem, Plus Orthopedics). The study was supported by Plus Orthopedics.

Methods: 98 patients were included in this retrospective study, all of them got a total hip replacement at the Orthopedic Department of the Kantonsspital Aarau between 2003 and 2007. In 48 patients (20 f, 28 m) there was used the Proxy-Plus-Stem, in 50 patients (23 f, 27 m) the CLS-Spotorno-Stem. The planned preoperative and the postoperative femoral offset was compared. For the measurement we used the preoperative planning x-ray and the postoperative x-ray. The Proxy-Plus-Stem was available in 10 sizes with up to 3 offset-variations. The CLS-Spotorno-Stem was available in 13 sizes and a CCD-Angle of 135° or 145°.

Results: In the group with the Proxy-Plus-Stems the mean of the planned preoperative femoral offset was 45,2 mm, compared to 45 mm postoperative. In the comparison group with the CLS-Spotorno-Stem the mean of the planned preoperative femoral offset was 44,8 mm, compared to 44,6 mm postoperative.

Conclusion: Our results show that there is no significant difference between the two stem systems concerning recreation of the femoral offset, although you have up to 3 different offset-variations with the Proxy-Plus-Stem.

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Treatment of a defect in the femoral head after traumatic anterior hip dislocation by surgical hip dislocation and osteochondral transplantation – a case report

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Introduction: Anterior hip dislocation is very rare. In the literature poor results are described in patients with additional large transchondral fractures. We describe the treatment and outcome of a 48 year old man sustained an anterior dislocation of the left hip after a motorcycle accident.

Methods: After closed reduction in the emergency room imaging analysis revealed a large osteochondral defect of the femoral head within the weightbearing area. The hip joint was exposed using surgical hip dislocation with trochanteric osteotomy 2 hours after accident. An osteochondral shell autograft (sized 15x10 mm) was harvested from the non weightbearing area of the femoral sphericity, transferred into the defect and fixed by two 2 mm screws.

Results: The postoperative CT scan showed anatomic reconstruction of the articulating surfaces of the femoral head within the weightbearing area. At the one year follow up the patient was free of pain and complaints. The function of the injured hip was comparable to that of the contralateral healthy hip joint. The radiographic analysis showed no signs of avascular necrosis. Heterotopic ossifications (Brooker II) were observed in the anterior aspect of capsule and cranial to the tip of the greater trochanter.

Conclusion: Anterior dislocations of the hip joint account for only 10% of all hip dislocations and are little described in the literature. Surgical hip dislocation with trochanteric flip osteotomy allowed full inspection of the hip joint and was efficient to treat the osteochondral femoral defect by osteochondral transplantation with a good functional outcome.

P 7

Surgical hip dislocation for the treatment of a fixed traumatic posterior dislocation with posterior acetabular wall and femoral neck fractures – a case report

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Introduction: Traumatic posterior hip dislocation associated with a posterior acetabular wall fracture and a fracture of the femoral neck is a very rare injury. We describe the emergent treatment and outcome of a 29 year old man after a bicycle accident with a fixed posterior hip dislocation.

Methods: Immediate CT scans at admission revealed fractures of the right medial femoral neck and the posterior acetabular wall. The hip joint was exposed within 5 hours after trauma by surgical hip dislocation with trochanteric osteotomy for open fracture reduction with preservation of the intact retinaculum. The femoral neck fracture was fixed with screws. Osteosynthesis of the posterior wall has been carried out using a steel plate. Inspection of the hip joint showed a tear of the acetabular labrum, which could be fixed by a metal anchor. The

patient was followed up for 1.5 years. To evaluate the reduction CT scans were used. Standard x-rays were used to assess prospectively for consolidation, signs of degenerative joint disease and occurrence of avascular necrosis in the femoral head.

Results: The postoperative CT scan showed anatomic fracture fixation. After 1.5 years of follow up partial hardware removal was performed in the femur. The function of the injured hip was comparable to that of the contralateral healthy hip joint without any radiographic signs for avascular necrosis or joint degeneration. The patient restarted skiing and hiking.

Conclusion: The combination of femoral neck and posterior acetabular wall fractures prevent closed reduction of a posterior hip dislocation. Surgical dislocation of the hip with trochanteric flip osteotomy allowed controlled open reduction of femoral neck and acetabular fractures with full inspection of the hip joint and preservation of the vascular supply.

Extensive heterotopic ossification of the hip after critical illness polyneuro-/polymyopathy

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Introduction: Heterotopic ossification (HO) is a benign formation of extraskeletal bone that may be acquired or occur idiopathically. It is described after brain or spinal cord injury, musculoskeletal trauma, burns and hip and pelvis surgery. Mechanism of this pathologic bone formation is not fully understood. Hypothesis include differentiation of mesenchymal stem cells to osteoblasts when a certain stimulus, such as inflammation, humoral factors, hypoxia of the tissue, hypercalcemia or prolonged immobilisation, is present. Due to arthroplasty, the hip is the site that is most frequently affected.

Case: A 58 year old patient was hospitalized for acute necrotizing fasciitis (ANF) of the ileofemoral area after bilateral intramuscular gluteal non-steroid-antiinflammatory-drug (NSAID) injections. He developed sepsis and emergent fasciectomy was performed emergently. During intensiv care survey the patient developed a palsy of the femoral quadriceps which was interpreted as a critical illness polyneuropathy/-myopathy (CIP/CIM). Two months after admission, a stiffness of both hips, right more than left, was noted. The range of motion (ROM) was highly limited with flexion/extension of 30/10/0° and minimal abd-/adduction and rotation capacity. Radiological imaging showed bilateral extensive HO of the dorsolateral musculature without involvement of nerves and vessels. After preoperative irradiation with 7 Gy, the resection of heterotopic bone was prudently performed on both sides with an interval of 12 days. Prophylaxis for HO with diclofenac was continued for 6 week after surgery. Functional results have been excellent with normal ROM one year after treatment.

Discussion: Even tough formation of heterotopic bone is prevalent, pathomechanism is not completely understood. Our patient had CIP/CIM. This neuromuscular weakness affects critically ill patients with an incidence up to 25%. Risk factors are sepsis, systemic inflammatory response syndrome and intravenous glucocorticosteroid administration. Generalized or limb weakness and loss of peripheral sensation recover after weeks to months. Together with long term immobilization and soft tissue lesion, CIP/CIM may be an additional risk factor to develop HO. As described in literature, a combination of surgery, irradiation and NSAID is postulated as therapy of choice. Our patient was treated very successfully with this procedure. He had normal ROM one year after intervention, is completely asymptomatic and is able to live a normal life.

P 8

Common radiological hip parameters are influenced by 3D variations of the entire acetabulum

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Diagnosis of residual acetabular dysplasia in adolescent and adults and recognition of spatial acetabular orientation is commonly made by parameters from AP and false profile radiographs. It is not clear, if these radiological features are influenced by local or general acetabular cup dysplasia, by malorientation of the entire acetabular cup, or both. The aim of this study was to examine the influence of three dimensional variations of the entire acetabulum on such radiological parameters. On 71 normal bony acetabula of males and females the contour of the acetabular rim and the orientation of the opening plane in relation to the pelvic frontal plane were measured. Through mathematical calculations, the outline of the mean acetabular rim measurements together with the corresponding mean acetabular opening plane could be shown as a two dimensional diagram, simulating the radiological projection of the acetabular rim. Mathematical variations of the opening plane in version, inclination and tilt in 5° increments were then performed. On the resulting

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diagrams we measured the lateral center-edge angle of Wiberg, the acetabular angle of Tönnis, the acetabular index of depth to width, the cross over sign, and the posterior wall sign. Mean acetabular version was 21°, mean inclination 48° and mean tilt 19°. High acetabular version (above 26°) as well as high acetabular inclination (above 53°) gave a lateral center edge angle and a acetabular index diagnostic for borderline dysplasia or for dysplasia. The posterior wall sign became positive for high tilt (above 34°) and low version (below 11°), and the cross over sign became positive in low version (below 16°). Acetabular index of depth to width changed little with all spatial variations of the opening plane. Three dimensional variations of the opening plane of a normal acetabulum are altering its radiological outline on a standard AP pelvic radiograph and may result in pathological radiological parameters acknowledged for acetabular dysplasia.

P 10

A pilot study for computed assessment of motion pattern and impingement free range of motion in Legg-Calve-Perthes disease

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Introduction: To our knowledge, computer-assisted analysis of motion patterns in Legg-Calve-Perthes Disease (LCPD) hips has not been performed yet. We developed an application for range of motion (ROM) simulation in LCPD patients.

Material and methods: We generated a virtual 3D computer model from a CT scan of a hip joint affected by LCPD. Secondly, a physical 3D specimen of the malformed femur and hemi-pelvis was formed by a 3D prototype printer. A simulation application based on the slightly modified equidistant hip joint simulation method was implemented. Using this application, we initially predicted the ROM based on the computer model mentioned above. Subsequently, the physical prototype model was equipped with dynamic reference bases, and was registered against the 3D computer model. For comparison to the predicted results, in-vitro ROM was then recorded using a previously implemented computer-assisted navigation application. An orthopaedic surgeon repetitively performed clinically relevant motions with the plotted bones and two different motion paths were recorded. Finally the computed motion paths were compared to the predicted hip joint ROM computed by the simulation software.

Results: Our simulation application was able to predict a hip joint ROM without producing intraarticular interference artifacts. 88.4% of the recorded motions in both paths were inside the predicted ROM.

Discussion: The modified equidistant method is capable of performing artifact-free range of motion analysis in distinct aspherical hip joints, by maintaining a constant joint space, by continuous recalculation of the best fitting femoral head sphere, which is consecutively superposed onto the acetabular sphere. Interestingly, our predicted motion paths closely resembled the clinical "Patrick"- and "Drehmann"-signs, which can frequently be found in LCPD. Further research is needed in order to consolidate these observations. Enrollment of more subjects and assessment by several examiners are currently planned.

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A novel and accurate method for automated detection of the acetabular rim

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Introduction: Assessment of the three-dimensional orientation of the acetabulum is difficult, but crucial for understanding many pathologies around the hip joint. We have developed an automated detection algorithm of the acetabular rim.

Material and methods: In a first computation step, the algorithm positions an initial estimated acetabular opening plane through the hip joint center. Subsequently, the distances between the pelvic points of the 3D model and the estimated acetabular true plane are determined. By projecting these distances against the true plane, a distance map can be generated. Based on medical image processing, the projected acetabular rim points on the distance map can be extracted. Utilizing simple back-projection, the acetabular rim points can be defined on the 3D model. For validation purposes, 5 sawbone pelvis (10 acetabular rims) were structurally modified at the rim, to exhibit different pathomorphologies. 3D models of these bones were generated with a handheld laser scanner. For validation, a navigation application was developed, mainly consisting of two parts: a registration module for performing a restricted surface matching and a landmark module being used for landmark acquisition under visual

control. The pelvic plastic bones were equipped with a dynamic reference base and a restricted surface matching was performed. After registration, two examiners digitized each acetabular rim 10 times using a tracked pointer. The distance between each digitized point and the next closest computed point of the automated acetabular rim detection was then calculated.

Results: The automated detection matched the summarized measurements of both examiners with less than 1 mm in 7 out of 10 acetabuli. The three outliers were off between 1.04 and 1.13 mm and the standard deviation was less than 0.7 mm in all measurements.

Discussion: Automated detection of the acetabular rim on 3D pelvic models using a computer application is possible with reliable accuracy when compared to visualized digitization of the rim using a tracked pointer. This provides a basis for numerous clinical applications for assessment of hip joint pathology.

P 12

A rare case of non-operative treatment of a late hematogenous group B streptococcal infection of a total hip replacement

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Introduction: Late hematogenous infections of hip arthroplasties are wellknown complications. Usually they are treated with a combination of operative debridement and systemic antibiotic treatment. Many cases of late hematogenous infections lead to removal of the prosthesis.

Methods: We report about a 84 years old male, who underwent hip replacement. Recovering well from the arthroplasty, he developed inguinal pain and fever 17 months after surgery. In a joint aspiration 13 ml of cloudy liquid could be evacuated. Group B streptococci were identified. Even though the Patient was advised repeatedly to undergo immediate surgical exploration of the hip, he refused any surgical treatment. He received a purely antibiotic treatment for a total of 3 months, leading to complete restitution of any symptoms within 2 weeks.

Results: The last follow up examination was performed 12 months after the infection. There was no clinical, radiological or chemical evidence of a persisting infection of the hip arthroplasty. The patient is active and leads a normal life.

Conclusions: There very few reports in literature about a complete restitution of an infected arthroplasty treated merely with antibiotics. In patients with a poor general condition, that refuse to undergo surgery, a merely antibiomatic treatment might be an option, if the diagnosis is early, and the involved bacterial agent is low-virulent and well antibiologically treatable.

P 13

Validation of a new method for determination of cup orientation in total hip arthroplasty

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The goal of this study was to validate accuracy, consistency, and reproducibility/reliability of a new method for determination of cup orientation in total hip arthroplasty (THA). This method allows matching the 3D-model of a CT with the projected pelvis on an anteroposterior (AP) pelvic radiograph using a fully automated registration procedure. Cup orientation (inclination and anteversion) is calculated relative to the anterior pelvic plane, corrected for individual malposition of the pelvis during radiograph acquisition. Measurements on blinded and randomized radiographs of 80 cadaver and 327 patient hips were used for investigation. The method showed a mean accuracy of $0.7^\circ \pm 1.7^\circ$ ($-3.7^\circ - 4.0^\circ$) for inclination and $1.2^\circ \pm 2.4^\circ$ ($-5.3^\circ - 5.6^\circ$) for anteversion in the cadaver trials and $1.7^\circ \pm 1.7^\circ$ ($-4.6^\circ - 5.5^\circ$) for inclination and $0.9^\circ \pm 2.8^\circ$ ($-5.2^\circ - 5.7^\circ$) for anteversion when compared to CT-based measurements. No systematic errors in accuracy were detected with the Bland-Altman analysis. The software consistency and the reproducibility/reliability were very good. This software is an accurate, consistent, reliable, and reproducible method to measure exact cup orientation in THA using a sophisticated 2D/3D-matching technique. Its robust and accurate matching algorithm can be expanded to statistical models.

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Computertomography with lower leg rotation in case of chronic proximal tibiofibular joint instability

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Introduction: A traumatic instability of the proximal tibiofibular joint (proxTibFib) occurs rarely and is frequently overlooked. The clinical and radiological diagnostic is particularly difficult in chronic cases, as the joint may dependent on the rotation of the lower leg alternate between a reduced and dislocated position. With the following case report we describe the possible advantage of the computertomography (CT) with varying rotational leg positions as a diagnostic option in a patient with a chronic proxTibFib instability.

Case report: A 23 year old female professional judoka sustained a traumatic spontaneously reduced knee dislocation during a match. After initial consultation of her general practitioner she presented with persistent pain and instability at a local hospital 6 weeks after injury. The diagnosis of a sustained knee dislocation (tear of the anterior cruciate ligament-ACL, partial tear of the posterior cruciate ligament-PCL, fibular avulsion of the biceps tendon and femoral avulsion of the lateral collateral ligament) was made. The patient was consequently treated with reconstruction of the ACL, a refixation with metal anchorage of the lateral collateral ligament and the biceps tendon. The associated proximal tibiofibular joint injury and posterolateral instability was overlooked. Postoperatively the patient felt unstable and an apparent posterolateral instability was treated with a brace. Ten months after trauma at initial presentation to our clinic the patient still felt unstable. Clinical examination revealed a gross laxity of the proxTibFib in combination with an increased posterior tibial translation. Flexion and extension was normal ($140^\circ - 0^\circ - 0^\circ$). In anteroposterior and lateral weight bearing radiographs the proxTibFib was suspicious for a subtle subluxation. For confirmation of the diagnosis a CT with neutral, internal and external rotation of the lower leg (patient supine, hip 70° flexed, knee 90° flexed) was performed. In contrast to the CT with neutral leg position the subluxation/dislocation of the joint was better detectable in CT with internally or externally rotated legs. A temporary arthrodesis of the proxTibFib in combination with a reconstruction of the anterior proximal tibiofibular ligament and a posterolateral reconstruction with iliotibial tract was performed.

Conclusion: The CT with neutral, internal and external rotation of the lower leg may be a promising diagnostic adjunct in patients with a chronic proxTibFib instability, if further studies confirm this finding of one exceptional case.

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Anatomic reconstruction of a chronically unstable calcaneocuboid joint – a new method

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Introduction: Chronic isolated calcaneocuboid joint instability is reported to be an uncommon problem following recurrent ankle sprains and inversion injuries of the foot. However, the frequency of chronic isolated calcaneocuboid joint instability is maybe higher than previously hypothesized. A novel, simple, less invasive, anatomically and effective operative technique for reconstruction of the dorsal calcaneocuboid ligament with an extensor digitorum brevis autograft is reported.

Case report: A 14 year old female presented with recurrent left ankle sprains within the last 2 years. Since then she reported activity related weight bearing lateral foot pain. Fear of recurrent giving way of the lateral foot and ankle was present. Initially the patient was treated with non-steroidal analgetics, immobilization and coordinative-proprioceptive training. But after sport pain on the left lateral foot recurred. Clinical examination revealed localized point tenderness over the calcaneocuboid joint, increased joint motion compared to the contralateral side. Pain worsened with inversion of foot. Ap. and lateral radiographs of the left foot did not reveal any pathology. Besides a minor hyperintensity at the cuboid, the T2- and PDW-MRI indicated no abnormality. Side-to-side stress radiographs demonstrated a relevant laxity of the calcaneocuboid joint during inversion of the foot. An intraarticular infiltration with local anesthetic led to temporary relief of pain until first sport exercise. A treatment with casting, taping and orthotic device was frustrating. Therefore a reconstruction of the dorsal calcaneocuboid ligament with an extensor digitorum brevis autograft was performed and is described. After surgery the foot was immobilized in a L-shaped cast in neutral position for 2 weeks. Then the cast was removed and full weight bearing with an orthotic stable shoe including a medial stabilizing inlay was initiated for 10 more weeks. Return to sport activity was allowed 12 weeks p.o. 6 months after surgery the patient was completely satisfied and successfully returned to school sport activity. The American Orthopaedic Foot and Ankle Society Hindfoot Scale and the Foot and Ankle Outcome Score (minimum 0 – maximum 100) was 100.

Conclusion: The presented case demonstrated good functional results in a patient anatomically reconstructed with an extensor digitorum brevis flap. Our operative technique is novel, simple, less invasive and effective for the treatment of chronically unstable calcaneocuboid joints.

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Avulsion fracture of peroneus longus tendon at the first metatarsal insertion: a case report

P 16

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Introduction: Isolated avulsion fracture at the plantar lateral base of the first metatarsal (M1) is very rare.

Case report: A 35 year old overweight woman sustained an eversion strain of her right foot. Despite pain along M1 she was able to continue walking for three days before presenting to her family doctor. Swelling on the plantar aspect of the foot was noticed, there was also pain at eversion of the foot and extension of the ankle. Plain X-ray showed no abnormalities. A MRI showed minimal bone bruise at the basis of M1 and a partial rupture of the peroneus longus tendon at its insertion. The patient was allowed to walk with partial weight bearing with a soft ankle brace. After 6 months she presented at our hospital because of persistent pain. There was still a painful insertion of the peroneus longus but active plantarflexion of M1 was possible. Plain X-rays were poorly contributive except for a discrete flattening of the longitudinal arch. CT-scan showed a non displaced fracture at the M1-basis. A protocol with partial weight-bearing in a short-leg cast and partial weight-bearing orthosis each for 6 weeks was unsuccessfully attempted. Therefore, an excision of the non healed bone fragment at the basis of M1 and a first tarsometatarsal joint arthrodesis were performed. Postoperatively the patient wore a partial weight-bearing short leg cast for 6 weeks followed by a weight-bearing short leg cast for 6 weeks with favourable outcome.

Discussion: Initial internal fixation has been reported to lead to good results [1, 2]. In our case the conservative treatment failed and led to non union. At that time we considered as too risky (overweight) to excise the fragment and reattach the peroneus longus tendon. Therefore, we excised the fragment and fused the first tarsometatarsal joint. This procedure allowed, at least partially, to compensate for the function of the peroneus longus tendon.

¹ Murakami T, et al. Avulsion fracture of the peroneus longus at the first metatarsal insertion: a case report. *Br J Sports Med.* 2004.

² Kwak HY, and Bae SW. Isolated avulsion fracture at the plantar lateral base of the first metatarsal: a case report. *Foot Ankle Int* 2000.

Tibio-talar arthrodesis with long anterograde nail after complex open fracture-dislocation of the ankle

P 17

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Introduction: Posttraumatic painful osteoarthritis of the ankle joint after fracture-dislocation often has to be treated with arthrodesis. In the presence of major soft tissue lesions and important bone loss the technique to achieve arthrodesis has to be well chosen in order to prevent hardware failure, infection of bulky implants or non-union.

Methods: We present the case of a 53 year-old biker suffering of a fracture-dislocation of the ankle associated with a mayor degloving injury of the heel. After initial immobilization of the lesion by external fixation in Spain the patient was transferred to our hospital for further treatment. The degloving injury of the heel with MRSA infection was initially treated by repeated débridement, changing of the configuration of the Ex Fix and antibiotic therapy with favourable outcome. Because of the bony lesions reconstruction of the ankle-joint was judged not to be an option and arthrodesis was planned. Due to bad soft-tissue situation standard open fixation with plate and/or screws was not wanted but an option for intramedullary nailing was taken. However the use of a standard retrograde arthrodesis nail comes with two problems: 1) Risk of infection of the heel-part of the calcaneus/nail in an unstable soft tissue situation with protruding nail. And 2) talo-calcaneal arthrodesis of an initially healthy subtalar joint. Given the situation of an unstable plantar/heel flap it was decided to perform ankle-arthrodesis by means of an anterograde nail with static fixation in the talus and in the proximal tibia.

Results: This operation was performed with minimal opening at the ankle-site in order to remove the remaining cartilage and improve direct bone to bone contact. Arthrodesis was achieved by means of an anterograde T2 Stryker tibial nail. One year after the anterograde nailing the patient walks without pain for up to 4 hours with a heel of good quality and arthrodesis is achieved.

Conclusion: Tibiotalar arthrodesis in the presence of mayor soft tissue lesions and bone loss can be successfully achieved with anterograde nailing.

Peroneus longus rupture with an associated fracture of the os peroneus: a case report

P 18

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Peroneus longus rupture with an associated fracture of the os peroneus is a well known entity although only 9 case reports have been described to date. The case of an acute peroneus longus tendon rupture through the os peroneus in a young professional football player is presented. Diagnosis of ankle sprain was reported initially. However careful clinical examination and MRI studies advocated peroneus longus rupture with associated fracture of the os peroneus. The lesion was successfully treated with end-to-end suture at the level of the os peroneus. The tendon lesion was initially missed and mistaken for an "ankle sprain". There are many lesions "around the ankle" that can be misinterpreted. Thorough, systematic and repeat clinical examination is mandatory to differentiate between the numerous traumatic lesions occurring around the ankle joint. Specific radiographic analyses are often required.

Atlas of standard radiographs of arthritis addendum: the ankle

P 19

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Introduction: Atlases of standard radiographs of osteoarthritis have been developed in order to lessen OA assessment variability. Only selected joints have been addressed though, based on frequency of affection and number of therapeutic options at disposal (requiring staging for indication). The ankle in this context was not accurately addressed until now. Evolution and innovations in the treatments of ankle OA in the last years now require reliable and comparable staging systems. Our objective was to develop an atlas of standard radiographs of ankle OA based on the revised Kellgren and Lawrence scale in order to facilitate and lessen variability of ankle OA staging.

Methods: Radiographs for which complete agreement between investigators was reached in the "Reliability of conventional ankle OA assessment and comparison with a novel computer based technique" study were selected. One set of film was retained for each of the levels of the Kellgren and Lawrence scale and is meant to be published as a supplement to the study.

Results: not applicable.

Conclusion: not applicable.

Operative treatment of a lisfranc luxation fracture Myerson type C

P 20

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We like to demonstrate a case of a 30 year old man who fall from a height of about 2.5 meters from a construction while working. His right foot got caught by a piece of a metal frame pulling it downwards in a sense of hyperflexion. In our emergency room the right foot was swollen and deformed. The forefoot was flexed; normal sensitivity and microcirculation. The dorsal artery was not palpable because of the swelling. Our X-ray images showed a divergent dislocation of all metatarsals in the lisfranc joint type Myerson C2 accompanied by fractures of medial and later cuneiforms and a subcapital fracture of the second metatarsal. The same day an open reduction and internal fixation was performed. The lisfranc 2–5 joint was transfixed with screws and the first ray was stabilized with a locking plate. Our patient had to avoid full weight bearing for 12 weeks. Thereafter all implants were removed and he started physiotherapy program increasing weight bearing. Six months after surgery he was able to continue his job as a constructor in a full time employment. Lisfranc injuries are often very serious. Their consequences are often underestimated. Therefore a high degree of suspicion is needed not to oversee these important injuries.....



Strain patterns induced by three different designs of first metatarsal osteotomy to treat hallux valgus

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Introduction: The scarf and modified chevron have become very popular first metatarsal (MTH1) osteotomies for the operative treatment of hallux valgus. Although the clinical results are generally satisfactory, several complications of mechanical nature have been reported for the scarf while the amount of correction remains limited for the chevron. In an attempt to combine the advantages of both osteotomy types, an intermediary design, the reversed-L osteotomy, has recently been developed at our institution. We hypothesized that the reversed-L would show an intermediate behavior in both the global (structural mechanical properties) and local mechanical response (cortical bone strains) of the bone.

Methods: Nine fresh-frozen human cadaveric MTH1 specimens were used in this experimental study. Three gages were glued circumferentially on the mid-diaphysis of each specimen for local strain measurement. The proximal end of each specimen was held fixed and the load was applied to the distal end in a universal testing machine. All bones were tested in two different loading configurations, cantilever and physiologic while the corresponding stiffness and strains were recorded. In a final step, the force-displacement curves of all specimens were measured when loading them to failure in the cantilever configuration. The fracture mode was observed by simultaneously recording a movie of the specimen using high resolution video cameras.

Results: Structural stiffness of the bones after surgery remained within normal values, but failure mode and local bone strains were both strongly influenced by the type of osteotomy. Cortical bone strains pattern and deformation mode were similar for the reversed-L, the chevron and the intact bone. The failure mode of the reversed-L osteotomy was comparable to the scarf, while in opposition to prior studies, poor primary stability through rotation of the distal segment was observed for the chevron.

Conclusion: The current study provides biomechanical support in favor of first metatarsal osteotomies with a plantar arm that extends proximally in order to enhance primary stability, but favors a short plantar arm in order to keep local deformations similar to the intact bone. This study confirms the intermediary design of the reversed-L as an effective compromise between these competing biomechanical objectives.

Posttraumatic ankle arthritis due to *Nocardia beijingensis*. First case outside of Asia

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Introduction: Nocardial arthritis in immunocompetent patients is rare. We report the first human infection (and arthritis) due to *Nocardia beijingensis* outside of Eastern Asia, highlighting the worldwide emergence of this new pathogen.

Case report: A 40 year-old epileptic patient subsided to a car accident in the Rhone Valley in France on 2nd May 2008. He revealed open fractures (grade-IIIb) of both ankles that were stabilised with intramedullar nailing in a peripheral hospital. The patient further received an empirical antibiotic treatment of amoxicillin/clavulanate during five days. After his transfer to Geneva University Hospitals, an elective revision was performed because of incongruence of articular surfaces. On 15 May, both nails were removed and the ankles were stabilised with external fixation devices. On 19 June, the patient witnessed new pain, erythema and a purulent discharge out of the scar of his right ankle. He had no fever and the serum C-reactive protein level was 52 mg/L. During lavage, pus was seen inside the talo-tibial articulation and all foreign body material was removed. The Gram-staining and microscopic examination did not show any pathogens or crystals. The patient was treated empirically with intravenous vancomycin 2 g/d and ceftriaxon 2 g/d. Five days later the cultures grew *Nocardia* spp, that subsequent analysis identified as *N. beijingensis*. The antibiotic treatment was changed to intravenous cotrimoxazole (160 mg trimethoprim, 800 mg sulfamethoxazol) for 5 days, followed by oral cotrimoxazole bid for a total of 8 weeks until 26 August 2008. During a forth and last lavage on 4 July, the surgical site was sterile. Cure was complete and the patient has no recurrence up to a follow-up of 5 months by now. No underlying immunosuppression could have been detected.

Conclusion: Contrary to traditional beliefs, the patient was successfully treated with only 8 weeks of cotrimoxazole after adequate surgical drainage.

Unsuccessful diagnosis and treatment in postoperative infection after ankle fracture: A case report

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A 47 year old lady (BMI 48) was operated on a bimalleolar fracture and developed an infection. During a period of 1 year she had 4 revision surgeries without adequate healing or pain reduction. In this situation of a chronic osteomyelitis of the medial malleolus after an antibiotic free interval a wide open extensive revision with removal of multiple tissue and bone samples for histological and bacteriological examination occurred. A staphylococcus aureus was verified. After that the patient got intravenous antibiotic therapy for two weeks till bone grafting was performed. Even postoperatively i.v. antibiotic therapy was continued for another week. Finally peroral antibiotics were applied for 3 months. Further follow-up showed a healed ankle region and unfortunately an advanced medial ankle arthrosis and limited motion. **Conclusion:** Unsuccessful diagnosis and treatment in postoperative ankle fracture infection may often result in an unresolved situation and development of advanced arthrosis. A big effort in bacterial diagnostic and longlasting correct antibiotic therapy is recommended for healing and avoiding arthrosis.

Pleomorphic hyalinizing angiectatic tumor (PHAT) mimicking a simple ganglion of the foot

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A 62 year old female presents with a large soft tissue lesion dorso-medially on the fore- and mid-foot measuring approximately 8x6x5 cm. She first noticed the lesion 6 years ago as a small bump. A simple ganglion was suspected by her surgeon and a resection was recommended based on a normal plain x-ray series. While the patient refused surgery, the lesion increased in size over the years without giving discomfort. 6 years later, blood was aspirated by her surgeon. The patient was then referred to our institution. MRI showed a large cystic and septated lesion with heterogenous contrast enhancement but no neurovascular, bony or tendinous involvement. A CT guided biopsy was performed, but histologically the specimen was non-diagnostic containing mainly fibrin masses with a small fragment of granulation tissue. An open biopsy revealed atypical mesenchymal spindle cell proliferation and a low grade sarcoma was suspected. Due to limited amount of tissue and unspecific immunophenotype the precise sarcoma subtype could not be determined. Based on this finding, resection with tumor free margins was performed. Histological analysis revealed a pleomorphic hyalinizing angiectatic tumor (PHAT). First described by Smith et al in 1996, PHAT is a rare soft tissue tumor of uncertain lineage. It occurs in superficial soft tissues of the distal extremities and features ectatic, fibrin-containing vessels with prominent circumferential hyalinizing spindle and pleomorphic stromal cells with a variable inflammatory component. PHAT is a low-grade neoplasm with a high risk for local recurrence. Neo-adjuvant or adjuvant therapies were not performed in our patient. Systemic metastases have not been described to date.

Outcome evaluation of ankle osteoarthritis treatments using spatio-temporal gait parameters and plantar pressure during unconstrained long distance walking

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P 25

Introduction: Ankle arthrodesis (AD) and total ankle replacement (TAR) are typical treatments for ankle osteoarthritis (AO). Despite clinical interest, there is a lack of their outcome evaluation using objective criteria. Gait analysis and plantar pressure assessment are appropriate to detect pathologies in orthopaedics but they are mostly used in lab with few gait cycles. In this study, we propose an ambulatory device based on inertial and plantar pressure sensors to compare the gait during long-distance trials between healthy subjects (H) and patients with AO or treated by AD and TAR.

Methods: Our study included four groups: 11 patients with AO, 9 treated by TAR, 7 treated by AD and 6 control subjects. An ambulatory system (Physilog[®], CH) was used for gait analysis; plantar pressure measurements were done using a portable insole (Pedar[®]-X, DE). The subjects were asked to walk 50 meters in two trials. Mean value and coefficient of variation of spatio-temporal gait parameters were calculated for each trial. Pressure distribution was analyzed in ten sub-regions of foot. All parameters were compared among the four groups using multi-level model-based statistical analysis.

Results: Significant difference ($p < 0.05$) with control was noticed for AO patients in maximum force in medial hindfoot and forefoot and in central forefoot. These differences were no longer significant in TAR and AD groups. Cadence and speed of all pathologic groups showed significant difference with control. Both treatments showed a significant improvement in double support and stance. TAR decreased variability in speed, stride length and knee ROM.

Conclusions: In spite of a small sample size, this study showed that ankle function after AO treatments can be evaluated objectively based on plantar pressure and spatio-temporal gait parameters measured during unconstrained walking outside the lab. The combination of these two ambulatory techniques provides a promising way to evaluate foot function in clinics.

The accuracy of visual feedback for gait rehabilitation under partial weight bearing

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Context: Medical instructions for partial weight bearing after lower limb surgery and fractures are commonly given to avoid complication during the post-operative recovery period. Physical therapy aims to teach the patients to respect partial target load when using crutches. Commonly used methods such as verbal instruction or bathroom scales are thought to be inadequate to obtain the prescribed target load during weight bearing performance, especially when target load are less than to 50% body weight. Therefore, disrespecting partial weight can have negative consequences, such as implant rupture or bone deformities.

Objective: 1) to evaluate the accuracy of visual feedback for gait rehabilitation under partial weight bearing. 2) To determine if patients could remember partial weight bearing instructions 7 days after the end of the training.

Method: After orthopaedic surgery, 30 patients, with whom one teaches a partial target load of the lower limb, are evaluated for the quality of acquired walk and the accuracy of partial weight bearing. The patients are those which have a lesion of a lower limb for which the orthopaedic surgeon asked for the training of a partial load. The load was recorded on a dual track treadmill with integrated double force gauge (ADAL treadmill). The vertical ground reaction force was monitored for 30s recording many successive steps and was related to the body weight. The loads were learned with visual feedback (real time visualization of the stance period on a screen in front of the patient, only during training phase). The evaluation was done at comfort speed before and after a training period of 5 days and after 7 days later to determine the retention effect.

Clinical relevance: The accuracy level of partial weight bearing is improved by visual feedback. This technique should be emphasized for patient with lower limb trauma or surgery needing a precise control of their partial weight bearing. There might be a long term learning effect as compared to poor retention effect with commonly used methods.

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A new radiation free targeting guide for intramedullary nails: Preliminary results of cadaver study

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One of the most demanding steps of intramedullary nailing is the distal locking. The aim of this study is to evaluate a new radiation free targeting guide on cadavers.

Material and method: The study was conducted on fixed cadavers. 24 femurs were available. The method consists of the following steps: determining the zero position of the device; opening the tip of the great trochanter; introducing the nail (Sirus nail® 12X400 (Zimmer Inc.)); introducing an emitter inside the nail to be positioned in the distal holes; adaptation of the guide on the standard handle with a receptor; moving the receptor to be aligned to the emitter; changing the receptor for the sleeve and performing the drilling and the locking. For the second or even third screw, the targeting device needs a little adjustment.

Results: On the 24 distal locking procedures, we observed only one failure due to the breakage of the prototype. This translates as a 96% success rate for two screws with a mean time of 7.4 minutes.

Conclusion: This new device has the advantage to be fully mechanical, to be solidly linked to the patient and to be totally radiation free. It can be used in any hospital, by any surgeon. The procedure is easy to learn and reproducible. It could be adapted to any nail system and does not need external power supply.

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The dual-helical osteotomy for simultaneous derotation and lengthening of long bones

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Introduction: Fractures of long bones which heal in a malposition or malrotation require correction by an osteotomy depending on the amount of deviation from normal. Ideally, correction is performed at the place where the deformation occurs. We report on a novel correction osteotomy in a case with posttraumatic malrotation and shortening of the femur after nailing of the diaphyseal femur fracture with consecutive posttraumatic arthritis of the hip and degeneration of the knee.

Material and methods: Our patient sustained a motorcycle accident in 1998 and received femoral nailing because of a comminuted femoral fracture. The nail was exchanged in 2001. In 2007 the patient presented his externally rotated leg and complained about ipsilateral hip and knee pain. No more internal rotation of the hip from the neutral position was possible. The femur was shortened by 2 cm and externally malrotated by 50 degrees. There was a posttraumatic arthritis of the hip after conservative treatment of a posterior wall fracture of the acetabulum. Before replacing the hip we considered a correcting osteotomy to derotate and lengthen the femur by applying a novel dual helical osteotomy. The helix angle and the distance of the transverse osteotomies are determined by the planned derotation angle and the correcting lengthening (see model).

Results: Simultaneous correction of malrotation and lengthening could be achieved by applying this type of osteotomy through a lateral approach and stabilizing it by plate fixation. The plate had to be replaced six months after surgery because of breakage, thereafter the femur showed complete healing. The patient reached full weight bearing, his knee pain disappeared and his hip pain was reduced. Total hip replacement with plate removal is planned now.

Conclusion: This type of osteotomy corrects malrotation and discrepancies in length of long bones simultaneously. A single, unilateral neutralizing plate provides sufficient fixation. The precise form of the osteotomy depends on how much correcting derotation and lengthening is planned. It can be computed precisely before surgery. No special instruments are required.

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Low utility of methicillin-resistant *Staphylococcus aureus* screening to predict staphylococcal species in orthopaedic implant infections

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Introduction: Staphylococcal implant infections are disastrous adverse events. In case of concomitant skin colonisation of by methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin is empirically prescribed while awaiting the microbiological results.

Methods: Retrospective study of staphylococcal orthopaedic implant infections in patients with concomitant MRSA screenings. MRSA screening (PCR and/or culture) from nares and groin were performed at maximum two weeks before microbiological diagnosis by intraoperative specimens.

Results: A total of 102 staphylococcal infections were retrieved (38 due to MRSA, 33 due to methicillin-sensitive *S. aureus* (MSSA), and 31 due to coagulase-negative staphylococci (CoNS). In 8/33 (24%) cases of MSSA and 4/31 cases (13%) of CoNS infections, the patients were detected MRSA-positive on their skins at the diagnosis of infection. Conversely, 42% (16/38) of patients with MRSA infections had negative MRSA screening results. Sensitivity was 58% for PCR & culture together, 58% for culture alone, and 60% for PCR alone. The corresponding specificities varied: 81% for PCR & culture together, 90% for culture alone, and 72% for PCR alone, respectively.

Conclusion: Concomitant MRSA skin colonisation does not predict the causative pathogen of underlying patients with staphylococcal orthopaedic implant infection.

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Minimal infection risk of elective total joint arthroplasty infections due to methicillin-resistant *Staphylococcus aureus* infections despite high endemicity in the hospital

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Background: The influence of a high endemicity of methicillin-resistant *S. aureus* (MRSA) for arthroplasty infections due to MRSA is unknown.

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Objective: To investigate the incidence of arthroplasties infections due to MRSA in Geneva University Hospitals (MRSA endemicity of 30%) and its association with patients' MRSA carriage.

Methods: Prospective cohort study of elective knee and hip joint total arthroplasties. Retrospective MRSA data from Laboratory of Bacteriology.

Results: A total of 6101 total joint arthroplasties (4002 hip, 66%, 2099 knee, 34%) were retrieved. 441 (7%) were revisions. In 47 episodes (0.8%) the patients were colonized due to MRSA before arthroplasty with a mean time delay between first detection and surgery of 15 months. Seven (0.11%) infections due to MRSA were retrieved in 7 patients. All were primary surgical site infections, except one case with haematogenous seeding due to endocarditis. Previous known colonisation, the absolute number of positive MRSA screening results, and the body mass index were associated with MRSA infection, while the time delay between first colonisation and surgery or the body site of colonisation were not. Adherence to hand hygiene recommendations were 65%. 62% of MRSA-positive patients were isolated in single rooms, 4% in mixed rooms, and 31% were cohorted in two-bed rooms.

Conclusion: A high MRSA endemicity and the proportion of MRSA-colonized patients do not influence infection risk of elective total hip and knee arthroplasty due to MRSA. Provided that surgery is correctly performed, hand hygiene, and other prevention issues are respected, the total incidence of MRSA infections may remain very low.

P 31

Use of serum antistreptolysin-O-titers in the microbial diagnosis of orthopaedic infections

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Introduction: The utility of serologic tests in the microbial diagnosis of orthopaedic infections is unknown.

Methods: Retrospective data from patients with musculoskeletal infections in whom ASO titer was performed in Geneva University Hospitals.

Results: A total of 21 patients (7 females, 14 males; median age, 64 years) with 21 symptomatic musculoskeletal infections were retrieved. In nine patients there were several specimens for ASO titer determination. The first specimen was obtained at a median of 13 days (range, 3 to 105 days) after the clinical onset of infection, and the last specimen at a median of 16 days. Test results were available within 1 and 5 days. In those patients without ASO elevation, median titers were 100 U/ml (range, <100 to 200 U/ml). Five patients had elevated ASO titers (10 specimens; median titer 600 U/ml, range 300–800 U/ml). These specimens were taken between day 6 and day 24, with a median value of 14 days for the first specimen. Among four patients with elevated ASO titers and multiple specimens, the titers reached a plateau at day 8 and day 18 in two patients, respectively, while they continued to rise at day 10 and day 18 in two other patients, respectively. All five patients with elevated ASO titers were treated with intravenous penicillin or amoxicillin. All were cured with no recurrence during a follow-up period of at least three months. The pathogens documented in the patients with elevated ASO titers were *S. pyogenes* (β -hemolytic streptococci of Lancefield group A; n = 3), β -hemolytic streptococci of group G (n = 1) and β -hemolytic streptococci of group C (n = 1).

Conclusion: Antistreptolysin-O titer determination is inexpensive and accurate in the diagnosis of β -hemolytic group A, C and G streptococci. In patients with negative culture results and positive titers antibiotics might be reduced to the narrowest spectrum, penicillin.

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Pregnancy-associated osteoporosis – a rare complication of pregnancy and lactation

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We report the case of a 27 year old female (24 + 2 weeks of gestation (WOG), 105 kg, 165 cm, GI, PO) who complained of severe pain in the right foot and left hip. Pregnancy controls have been normal.

Laboratory screening showed a positive IgG titre and a questionable positive IgM titre for Lyme disease. She was treated with amoxicillin. The ultrasound scan of the left hip showed a thickened joint capsule without effusion or local hyperaemia. The MRI showed a severe bone oedema in the femoral neck fitting with the diagnosis of a transient osteoporosis. Due to the pain she was immobilised and 7500 IE/die of s.c. heparin were administered. With physico-medical treatment she suffered an initial pain relief. In the 26. WOG pain relapsed. In the 38 + 1 WOG pain became disabling in the left hip so that a caesarean section was performed and a healthy girl delivered. Postpartum a mobilisation of the patient was impossible due to disabling pain in both

feet and knees, predominantly on the right side. The patient refused breastfeeding to have her pain sufficiently treated. The radiological controls showed a severe, inhomogeneous periarticular demineralisation of the knee-joints and feet, aggravated on the right side and the left hip. With restricted weight-bearing the patient was mobilised with a walker and crutches. Additionally she was administered paracetamol (4* 1 g) ibuprofen (3* 600 mg), calcitonin intranasal (2* die), high-doses of Vit D3 (3* 400 IE) and calcium (3* 500 mg). Pregnancy associated transient osteoporosis is a rare entity of unknown origin. In the literature we found only case reports but a lack of bigger or randomised studies. The natural history of the disease is benign with a complete relapse within 6 to 24 months. In the literature we found hyperlipidemia, hepatic cirrhosis, s.c. heparin and vascular abnormalities as possible risk factors for the development of a transient osteoporosis. An association with CRPS is also discussed.

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Role of ultrahigh-molecular-weight polyethylene particles on the antibacterial activity of macrophages

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Background: A major complication of total joint arthroplasty is microbial infection. Wear particles of ultrahigh-molecular-weight polyethylene (UHMWPE) released from prosthesis are phagocytosed by macrophages in periprosthetic tissues. *In vitro* studies showed that phagocytosis of UHMWPE particles by neutrophils impaired their bactericidal activity, potentially explaining the susceptibility of prosthesis to microbial infection. In this study we test whether UHMWPE particles also alter the antibacterial activity of macrophages.

Materials and methods: Bacterial killing by mouse bone marrow derived macrophages (BMDM) against a clinical and a commensal strain of *Staphylococcus epidermidis* (*S. epidermidis*) was determined by counting the number of surviving bacteria. The clinical strain is an epidemic clone (ST 27) isolated from prosthesis infection. The production of TNF α was measured in the culture supernatants by ELISA. UHMWPE particles were generated *in vitro* from a prosthetic material and stained with rhodamine. Phagocytosis of particles by BMDM was performed using an inverted co-culture method, and the association between particles and macrophages evaluated by fluorescence microscopy.

Results: The percentage of bacteria surviving inside macrophages did not differ between the clinical and commensal strain, but the production of TNF α was significantly higher with the clinical strain. Fifty one percent of BMDM were associated with UHMWPE particles after 24 hours of inverted co-culture.

Conclusion: The two strains of *S. epidermidis*, survive equally well in macrophages but the clinical strain generates a more pronounced pro inflammatory response. The impact of wear particles on the intracellular fate of GFP-expressing bacteria will be quantified by automated fluorescence microscopy.

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Medical prophylaxis of osteoporosis versus bone healing?

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Background: The use of Bisphosphonates for prophylaxis of osteoporosis-related fractures has become increasingly popular. The benefit of this medication is undoubtful. However reports of limited remodeling of bone caused by these substances and subsequent fractures or delayed bone healing are increasing.

Case: We report of a 77-year-old patient with a periprosthetic fracture around the distal femur. The fracture was initially correctly reduced and stabilized by a LISS-plate (Synthes GmbH, Switzerland), taking care NOT to violate blood supply to the fracture site. The patient had been in continuous medical treatment against osteoporosis with different bisphosphonates for the past 16 years. In the postoperative course no osseous reaction could be detected – for months! Eventually four months after reduction a fatigue fracture of the plate occurred, without additional trauma. The fracture site at revision was inspected: No formation of any callus was detected.

Discussion: Currently there are several case reports and even records of series of (stress) fractures of the proximal femur without trauma in patients treated with bisphosphonates [1, 2]. Also reduced strength of callus under this therapy has been observed [3].

Conclusion: Bisphosphonates should be used critically, especially those with a long-lasting effect. Further studies are needed to determine the exact role of these especially in bone turnover and bone healing.

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P 35

Prediction and optimization of bone density around orthopaedic implants delivering bisphosphonates

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Introduction: The fixation of an orthopaedic implant depends strongly upon its initial stability. Peri-implant bone may resorb shortly after the surgery. This resorption is directly followed by new bone formation and implants fixation strengthening, the so-called secondary fixation. If the initial stability is not reached, the resorption continues and the implant fixation weakens, which leads to implant loosening. Previous studies with rats and dogs have shown that a solution to prevent early peri-implant resorption is to deliver bisphosphonate from the implant surface. The aims of the present study were first, to develop a theoretical model of bone remodeling around an implant delivering bisphosphonates based on available data. Second, to use the model to predict the dose of zoledronate that would induce the maximal periprosthetic bone density. Third to verify in vivo that the periprosthetic bone density is maximal with the calculated dose compared to previously tested doses.

Methods: Twelve female 6-month-old Wistar rats were randomly separated into 6 different groups representing 2 zoledronate doses (0.3 µg and 2.1 µg/implant) and 3 timepoints (3, 6 and 9 weeks). Each rat received one implant in a femoral condyle. Twelve Ti-alloy cylinders were plasma-coated with hydroxyapatite (HA) and then soaked in aqueous solutions of zoledronate for 48h. After surgery, all the animals were allowed to move freely in their cages.

Results: At 3 weeks, the bone was in contact with the HA coating surface, without signs of resorption in the coating and almost no bone entering the coating. At 6 weeks, the first signs of resorption appeared in the coating. At 9 weeks, most of the coating had been resorbed and newly formed bone was in contact with the titanium surface. At 3 weeks, the model's predictions were verified. The mean bone density of the group with optimal zoledronate dose was 4% greater than the highest bone density obtained so far.

Conclusion: A theoretical framework of bone remodeling influenced by local release of zoledronate was developed, found accurate and used to optimize periprosthetic bone density.

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In vivo optical bioluminescence imaging of human myoblasts after intramuscular injection in mice

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After severe muscle injury, desmote regeneration that begins within two weeks, there is formation of fibrotic scar tissue which can cause complications for both professional and amateur athletes. Current treatments remain suboptimal and novel strategies including myogenic progenitor cell therapies are currently under investigation.

Nevertheless, such therapies are limited by a massive early cell death following injections. In the present study, we describe a noninvasive approach for the rapid and accurate evaluation of myoblast survival and proliferation post transplantation. For this purpose, human myoblasts were transduced with a lentivirus containing the renilla-luciferase (Rluc) gene under a HSV-TK promoter. Rluc transgene expression had no adverse effects on myoblast viability, proliferation, or differentiation in vitro. Increasing number of Rluc transduced or control untransduced human myoblasts (10^4 to 5×10^5 cell) were injected in the tibialis anterior (TA) muscle of NOD/SCID mice. Cell survival was evaluated using optical bioluminescence imaging (BLI) on days 1, 4, 7, 10, 14, 21, 28, 35, 42 and 56 after surgery. In vivo, BLI revealed a robust correlation between Rluc signals and cell numbers immediately post transplantation ($R^2 = 0.98$) while only background level of signal was observed within control cells. Rluc signals intensity from TA muscle decreased significantly at day 1, 4 and 7 post injection to reach background level at day 10 post injection. These data indicate an acute donor cell death within 2 weeks post injection. These preliminary results demonstrate the ability of optical molecular imaging

for tracking cell survival noninvasively. With further development, this approach will help to improve myoblast transplantation biology, notably by facilitating the screening for therapeutic agents acting on grafts.

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Case Report: Coexistent gouty and pseudogouty arthropathy in total knee arthroplasty

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Introduction: Gouty arthropathy after arthroplasty has already been described. Our case seems to be the first with coexistent gouty and pseudogouty arthropathy in a total knee arthroplasty.

Case report: A 61-year old patient without history of medical diseases was admitted to our emergency department with acute severe pain, erythema and effusion of the right knee. The white blood-cell count was elevated to $172 \times 10^9/l$ (norm: $3.9-10.2 \times 10^9/l$) and the c-reactive protein was 70 mg/l (norm: $<5 \text{ mg/l}$). The orthopaedic history revealed a implantation of a primary total knee arthroplasty 12 years ago and two subsequent revisions due to aseptic loosening. An arthroscopy was performed and from a pouch a purulent appearing cloudy fluid spread out. The synovia showed a few crystal-like white speckles.

The results of the analysis of the synovial fluid showed an elevated cell count ($44.9 \times 10^9/l$) and plenty of monosodium urate crystals as well as pyrophosphate crystals, evidentiary for gout and pseudogout. The white cell differential count showed 77% polymorphnuclear cells (gout normally between 60 and 90% and infection $>90\%$). In the culture, no bacteria could be detected. The patient received non-steroidal anti-inflammatory drugs and cortisone for a few days. Quickly the patient recovered and was dismissed. Clinical and lab controls 1, 2 and 3 weeks later didn't show any signs of inflammation.

Discussion: Gouty arthropathy and infection in a total knee arthroplasty are both characterized by acute severe pain, erythema and effusion together with increased white blood-cell count and inflammatory markers. Crystals in the synovial fluid are usually evidence for gout or pseudogout. Absence of crystals however does not exclude a crystal arthropathy. Polarized light microscopic examination can detect birefringent needle shaped monosodium urate crystals. Our case shows how important it is to be aware of crystal arthropathies as a differential diagnosis to infection in total knee arthroplasties, especially considering the completely different therapy and to avoid unnecessary and extensive surgery.

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Arthroscopy: The toll for orthopaedic surgery in a changing world

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Introduction: In western countries knee arthroscopy is a well standardized operative procedure. In emerging nations like Vietnam this procedure is only performed in specialized centers (university hospitals) and therefore has a high potential of development. The goal of our project is the introduction of knee arthroscopy as a standard operative treatment. The arthroscopical techniques shall be taught in separate courses (1–2 weeks) twice a year.

Methods: From January 10–24, 2009 two orthopaedic surgeons and a technical operation nurse from Bruderholz Spital organized a basic course about knee arthroscopy in Orthopaedic and Rehabilitation Center, Da Nang, Vietnam. The 1st week included arthroscopy on knee models (Fa. Storz) and training of the setting in the OR. In week 2 we performed arthroscopies on 9 patients.

Results: Arthroscoping knees was introduced as a new surgical treatment. A standardized procedure was worked out under the given conditions. As often seen in emerging countries, unfortunately the indication for knee arthroscopy was mainly osteoarthritis (7/9 patients). The technical equipment sponsored by the VNH Foundation arrived with a delay of several days (shaver) or even after our departure (sterilizer, operating table).

Discussion: Introducing knee arthroscopy, which is well established in western countries, was harder than we expected due to language barriers, missing technical equipment and unexperienced local staff. Also the indication for operative treatment is different in countries with missing option of arthroplasty. Often compromises had to be found and improvisation was necessary. There is still a lot of space for improvement for future courses. A stepwise learning and a constant approval of the technical environment seems to be extremely important for the further success of this project.

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Results of computer assisted navigation in Total Knee Arthroplasty (TKA): Comparison with the conventional method

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The aim of this retrospective study was to compare the clinical and radiographic results after TKA (PFC, DePuy), performed either by computer assisted navigation (CAS, Brainlab, Johnson&Johnson) or by conventional means.

Material and methods: Between May and December 2006 we reviewed 36 conventional TKA performed between 2002 and 2003 (group A) and 37 navigated TKA performed between 2005 and 2006 (group B) by the same experienced surgeon. The mean age in group A was 74 years (range 62–90) and 73 (range 58–85) in group B with a similar age distribution. The preoperative mechanical axes in group A ranged from -13° varus to $+13^\circ$ valgus (mean absolute deviation 6.83° , SD 3.86), in group B from -13° to $+16^\circ$ (mean absolute deviation 5.35, SD 4.29). Patients with a previous tibial osteotomy or revision arthroplasty were excluded from the study. Examination was done by an experienced orthopedic resident independent of the surgeon. All patients had pre- and postoperative long standing radiographs. The IKSS and the WOMAC were utilized to determine the clinical outcome. Patient's degree of satisfaction was assessed on a visual analog scale (VAS).

Results: 32 of the 37 navigated TKAs (86.5%) showed a postoperative mechanical axis within the limits of 3 degrees of valgus or varus deviation compared to only 24 (66%) of the 36 standard TKAs. This difference was significant ($p = 0.045$). The mean absolute deviation from neutral axis was 3.00° (range -5° to $+9^\circ$, SD: 1.75) in group A in comparison to 1.54° (range -5° to $+4^\circ$, SD: 1.41) in group B with a highly significant difference ($p = 0.000$). Furthermore, both groups showed a significant postoperative improvement of their mean IKSS-values (group A: 89 preoperative to 169 postoperative, group B 88 to 176) without a significant difference between the two groups. Neither the WOMAC nor the patient's degree of satisfaction – as assessed by VAS – showed significant differences. Operation time was significantly higher in group B (mean 119.9 min.) than in group A (mean 99.6 min., $p < 0.000$).

Conclusion: Our study showed consistent significant improvement of postoperative frontal alignment in TKA by computer assisted navigation (CAS) compared to standard methods, even in the hands of a surgeon well experienced in standard TKA implantation. However, the follow-up time of this study was not long enough to judge differences in clinical outcome. Thus, the relevance of computer navigation for clinical outcome and survival of TKA remains to be proved in long term studies to justify the longer operation time.

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Surgical management of the rupture of the tibialis anterior tendon

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The rupture of the tibialis anterior tendon is a rare injury. It can be caused by direct closed trauma of the anterior ankle region or by forced plantar flexion against resistance. Spontaneous tendon ruptures are associated with rheumatic or metabolic diseases or after local application of corticoids. In literature there are only single or grouped case reports of tibialis anterior ruptures. Treatment procedures have been discussed diversely, but it is generally accepted that active patients are best treated surgically. The best functional results are provided by a direct tendon repair. Non-anatomic repair, tendon lengthening or a tendon transfer might be necessary in cases where there is shortening of the muscle-tendon unit. We report two cases of surgical management by direct anatomic repair. In the first case a direct tendon repair was possible even after a delay of 6 months. The second case describes and illustrates a direct tendon repair enforced by a tenodesis to the extensor retinaculum.

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Acute knee locking due to a localized pigmented villonodular synovitis – A case report

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History: A 27-year old female presented with an acute knee extension deficit after distortion of the left knee. She engages in volleyball as a hobby and up to now she did not remember any injuries of the left knee, especially no locking of the knee.

Clinically: Few hours after trauma: little effusion with limited range of motion flexion/extension $110^\circ/15^\circ/0^\circ$. Clinical tests for ligament lesion were negative. Even after an intraarticular instillation of local anesthesia the mechanical locking of the knee could not be solved. Meniscal pathology could not be excluded.

Magnetic Resonance Imaging: Shows a well-circumscribed soft tissue mass protruding anteriorly between the femoro-tibial jointspace. WxHxD $16 \times 9 \times 19$ mm.

Knee Arthroscopy: A single large ovoid livid nodule with macroscopically visible hemorrhages was removed arthroscopically and tissue was sent for histology. U-shaped tissue connection to the anterior horn of the medial meniscus as well as to antero-medial capsule and Hoffa fat pad. Was seen. No adhesion to the anterior cruciate ligament, both the anterior-medial and the postero-lateral bundle were unharmed therefore a cyclops lesion was very unlikely.

Histology: Mostly necrotic fibrosed connective tissue proliferation with loose round cell infiltrate. Few giant cells are discernable. Marked hemosiderin deposits are present. The findings are suggesting a localized giant cell tumor. Other neoplasia or meniscusganglion were excluded.

Discussion: Pigmented villonodular synovitis involves proliferation of the synovialis of joints, bursa or tendon sheaths. It is a rare disorder that can occur in two forms: the diffuse form is much more common and the entire synovialis is affected (which was not the case). The localized form involves just a section of the synovialis and almost always a single joint, most commonly the knee joint. The speciality in this case report is that the fibrohistiocytic tumor only became symptomatic after trauma. Due to the fact that giant cell tumor is characterized by special vascularisation pattern and the vessels may show abnormal structures most probably the acute knee locking was caused by an enlargement of the tumor through increased blood depositions.

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Design and Development of an orthopaedic instrument for anterior cruciate ligament reconstruction. Do we need two aiming devices?

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Introductions: One of the most controversial areas in Orthopaedics is the reconstruction of the anterior cruciate ligament (ACL). The current twin-instrument method for locating the ACL (bone tunnel) is (often) difficult for the surgeons, with fewer than 500 surgical experiences. This was clearly demonstrated by Kohn et al and Busche and Cans (1995). The above research indicates that the problem is not only one of anatomical location, but of how the operation takes place. The purpose of the research was to design a novel easy instrument that simplified the surgical techniques and technical demands placed on orthopaedic surgeons when performing reconstructions of the anterior cruciate ligament (ACL). Within this process, iterative case studies were employed in order to design a new surgical device for ACL reconstruction. The thesis describes a series of designed devices (case studies) that were iteratively developed and surgically tested, leading to a penultimate device. This latter device was tested via a number of surgical operations.

Methods: In 30 magnet resonance imaging (MRI) we analyzed the anatomical intraarticular relations of the ligaments and the anatomical landmarks. Due to this study the femoral as well as the tibial guide of an already clinical used instrument for ACL reconstruction have been completely new designed and used in a cadaver-study ($n = 10$) to verify the results. To check the positive results, the correct position of the tibial and femoral tunnels was evaluated by MRI. Finally the new developed instrument was used at 10 ACL reconstructions and postoperatively checked by MRI.

Results: The results of the different MRI and cadaver-studies lead to a completely new design of the ACL guide instrument. The anatomic designed femoral guide and the possibility of a variable tibial access result in an clinically relevant independency of a patient's anatomy. Additionally it was possible to perform the tunnel drilling in only one step that simplifies the operation technique. The postoperative MRI results show the correct position of the tibial and femoral tunnel.

Conclusion: Using of the new instrument during ACL reconstruction simplified the operation and saves time.

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Retrospective analysis of three operatively long bone fractures of the lower leg with delayed bone healing after LCP

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Introduction: Fractures of the lower leg are the most frequent fractures of long bones. Because of the instabilities and displacement most of the cases have to be treated operatively by intramedullary nailing or plate osteosynthesis. During the last few years there has been an upward tendency of the application of angle stable implants, most of the time a Locking Compression Plate (LCP). This can be used either in the way of an internal fixator or because of the combi-holes as a compression plate. This paper reports three cases of patients with pseudarthrosis.

Methods: Retrospective analysis of three patients with long bone fractures of the lower leg treated by LCP. Two patients showed closed fractures, one patient had an I° open fracture of the lower leg. Reposition of closed fractures was performed half-openly: Distal medial approach and subcutaneous insertion of the plate toward proximal (MIPO). The open fracture treated by open procedure. In all cases angle stable screws were applied, so that no compression occurred. All postoperatively taken X-ray images showed a correct position of the plate, one case with a varus malalignment of 6°. Postoperative partial weight-bearing of 10–15 kg was allowed to patients with primary closed fractures, no weight-bearing was allowed to the patient with an open fracture.

Results: All three described cases showed a delayed bone healing. Consolidation just occurred after 1,5 years. In the case of the one patient with a primary closed fracture after formation of hypertrophic callus. In the other patient with a closed fracture consolidation developed after one year with a varus malalignment of 6°. In the case of the open fracture a breakage of the plate took place after ten month and mobilisation under full weight-bearing. Computer tomography revealed a callus development without consolidation of the fracture.

Conclusion: LCP is an appropriate implant for the treatment of the fractures of the lower leg especially for multifragmentary fractures. However, our cases indicate that pseudarthrosis tends to be more frequent in patients treated with LCP than in those with conventional plates or intramedullary nailing. Possible reasons are the lack of compression potentially followed by small fractures gap and too rigid fixation by LCP.

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Doublerow / Suturebridge rotator cuff repair with classic titanium anchors

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Introduction: Arthroscopic techniques are becoming the gold standard in Rotator Cuff Repair. (RC-Repair). Doublerow techniques seem to be superior to singlerow techniques. In addition to standard anchors for the classic techniques special anchors and systems to fix the lateral row have been developed recently. These technical improvements do however come at additional costs. The goal of this paper is to present a reasonable, non-expensive, alternative for Doublerow / Suturebridge RC-Repair.

Material: For medial row fixation in arthroscopic RC-Repair a Titan Corc Screw Anchor armed with 2 sutures. (Mitek® Fastin RC 5.0 w/ 2 x Orthocord No.2) was used. For fixation of the lateral row the sutures of the medial row are passed through Mitek® RC Anchors creating a Suture Bridge and are then tied down.

Discussion: The presented technique offers a simple and reasonable way for arthroscopic Doublerow / Suturebridge Repair with utilizing (cheaper) Titan Anchors than the new, specially designed tools.

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Bilateral traumatic anterior shoulder dislocation – Case report

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Introduction: Traumatic shoulder dislocation is a common injury. Bilateral traumatic shoulder dislocations however are rare. Most cases of bilateral shoulder dislocations described in the literature are posterior dislocations due to seizures. The few reported anterior bilateral shoulder dislocations were caused by high energy trauma and mostly due to fracture associated dislocations.

Case report: A 21 year old male entered the emergency department at 3 am complaining about bilateral shoulder pain after falling while trying to perform a handstand. Clinical assessment showed bilateral anterior shoulder dislocations which was confirmed by x-ray. No neurovascular deficits were present and simultaneous reduction of

both shoulders was performed with the Davos method under analgosedation. (Davos Method: The patient is in a supine position and holds his flexed knee with both hands, relaxes and leans backwards letting the body weight perform the reduction of the shoulder). The reduction was documented by x-ray and there was no sign of neurovascular trouble. Both shoulders were put in a brace and the patient was dismissed and supposed to report at our department after seven days for further evaluation and aftertreatment. The medical history of the patient showed three dislocations on the left side before and radiologic signs of Hill-Sachs and Bankart lesions. Unfortunately he didn't return to follow-up.

Discussion: Only the direction of the force by falling while performing a handstand combined with the axial direction of the body weight can have caused this bilateral shoulder dislocation. Simultaneous reduction of bilateral shoulder dislocations can easily be achieved with the Davos method, which allows the application of a symmetric force to both shoulders with the knee as a hypomochleon to reduce both at the same time.

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Four corner Fusion in treatment of SLAC wrist – An alternative method using an autologous «bone plate»

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Introduction: Scaphoid excision and four corner fusion is considered as treatment of choice for scapho-lunar advanced collapse. Different methods of fixation are common, including K-wires, circular plate fixation, and screws. As the non-union rate is quite high, there are ideas for a more biological osteosynthesis. In the 1980s, Goth described a method using autologous pelvic bone as an additional biologic "bridging" in hand surgical procedures. We followed the idea to use an autologous, cortico-cancellous plate from the iliac bone, in order to improve the healing rate of our four corner fusions.

Methods: Since 2008, we treated six patients with SLAC wrist using the following method: 1) scaphoid excision, 2) abrasion of the articular surface, 3) Herbert screw fixation, 4) implantation of a dorsal iliac bone plate fixed with cortical screws. The cylindrical iliac bone plate was harvested with the Martin iliac crest trepan (KlsMartin Group, Germany). Three of the patients were female and three were male. Patients were reevaluated clinically and radiographically six weeks after surgery. The rehabilitation consisted in six weeks of immobilization followed by ergotherapy.

Results: Until now, we find a healing rate of 100 per cent after six weeks. One re-operation was necessary because of posterior screw impingement in wrist extension.

Discussion: Scaphoid excision and four corner arthrodesis is a common operation for treating scapholunar advanced collapse. However, the nonunion rates are quite high, ranging from 3% to 26% in the literature, depending on the method. As an option, we propose the use of an autologous bone plate from the iliac crest fixed by screws, which can easily be harvested with a special trepan instrument. In our experience, this technique leads to a high fusion rate and offers good stability without artificial plate material. Normally, screw removal should not be necessary. An alternative method is the use of the excised scaphoid bone as biological plate, which is in our experience more difficult due to the considerable sclerosis within the degenerated scaphoid bone. However, additional data is necessary to prove this method.

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Pectoral head height and tuberosity fixation with a tubular plate to restore proximal anatomy in hemiarthroplasty for irreparable proximal humeral fractures. Technique and first clinical results

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Introduction: Correct prosthetic height and anatomical reduction of the tuberosities are known to correlate with better functional outcome in hemiarthroplasty for irreparable proximal humeral fractures. In this study clinical and radiographic results after hemiarthroplasty reconstruction using a new method to determine prosthetic height, the Pectoralis Head Height (PHH), combined with a tubular plate fixation of the tuberosities are presented.

Patients: 10 patients (2 male, 8 female) with an average age of 77 years (59 y – 93 y) were treated consecutively for an irreparable PHH with hemiarthroplasty.

Method: Based on an anatomical study performed earlier by the senior author, prosthetic height was determined as the point situated 53 mm over the lateral humeral insertion point of the pectoralis major tendon (PHH). The implant was cemented distally according to the PHH and with 20° retrotorsion. Humeral head size was determined intraoperatively using the original head as template. After implantation

a 5 or 6 hole tubular AO plate was fixed to the humeral shaft laterally from the pectoralis major with 2 or 3 screws. The proximal part of the plate was bent exactly to the top of the humeral head. The tuberosities were then reduced anatomically over the plate and fixed to the plate, with several Nr 6 Ethibond sutures after autologous grafting of the space between plate and prosthesis. All but one patient could be evaluated clinically and radiographically 6 weeks po. 8 patients were available for final follow-up 2 years after surgery.

Results: At 6 week po no patient had pain at rest. Humeral length, compared to a calibrated x-ray of the complete contralateral humerus was restored within a range from + 5.88 mm to -12.5 mm (average -1.5 mm). In only one patient tuberosity displacement (leeser) was observed. At final follow-up (N = 8) two patients had had revision surgery (1 periprosthetic fracture, 1 reversed procedure for pseudoparalysis after early displacement of the lesser tuberosity). The average relative Constant/Murley score of the remaining patients (N = 6) was 76% (54–100%).

Conclusions: The described technique leads to lasting restoration of the proximal humeral anatomy and good shoulder function according to Neer in a promising high proportion of patients compared to other techniques.

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Early and midterm results after humeral blade plate fixation an functional treatment of unstable surgical neck fractures in the elderly

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Objectives: Temporary loss of function of the upper extremity due to immobilization for treatment of unstable proximal humeral fracture (PHF) is a very disabling condition in the elderly patient. Stable fixation of such fractures allowing immediate functional aftercare may contribute to early psychosocial reintegration in this group of patients. Aim of this study was to analyse the clinical and radiographic results after fixation of unstable PHF with a humeral blade plate followed by immediate functional treatment in patients older than 60 years.

Patients: 12 patients (3 m, 10 f) with a mean age of 75 years (59y – 93 y) were included in this study and treated consecutively for an unstable/displaced surgical neck fracture with a humeral blade plate. Postoperatively functional treatment was allowed. All patients had a clinical and radiographic follow-up 6 weeks po. At an average final follow-up of 18,8 months (12–24 months) 4 patients had died from causes unrelated to surgery.

Results: Surgery was performed in all patients without local and general complications despite comorbidities. In all patient anatomic reduction and stable fixation could be achieved. 6 weeks po all patient (N = 12) were free of pain at rest, 6 patients had low pain (VAS<4) when actively moving the arm. All patients used their operated arm for ADL and were back home or in the institution they came from at the time of trauma. All fractures were deemed to be healed without implant failure. In two cases a clinically asymptomatic 1–2 mm protrusion of the blade through the subcondral bone was observed but did not require further surgery. At the final follow-up (N = 8) the average absolute Constant/Murley score was 68,6 points (contralateral 71,4). Radiographically all fracture were healed without complications. Implant removal was not required.

Conclusions: In this small series, fixation of unstable PHF with a humeral blade plate has shown to be a safe and reliable therapeutic option allowing immediate functional treatment and early social reintegration in the elderly.

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Conservative treatment of scaphoid nonunion in children and adolescents

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To report the outcome of a series of pediatric patients with nonunion of scaphoid fractures treated conservatively. This retrospective study was performed with 6 patients with a mean age of 12.8 years (range 9.7 and 16.3). All but one had a failure of primary diagnosis. Radiological signs of a non-union of the scaphoid were found at a mean of 4.6 months post injury, ranging from 3 to 7 months. Treatment consisted of a spica cast immobilization until clinical and radiological union could be documented. The final clinical follow-up examination and radiological evaluation was at a mean of 67 months, (range 17 to 90). We assessed the patient history, wrist arc of motion and grip strength to calculate the Modified Mayo Wrist score. Union of the fracture could be documented in all patients after a mean immobilization of 5.3 months, ranging from 3 to 7 months. Five patients were pain free, one had mild pain. All patients returned to regular activities, and had a

range of motion and grip strength within 25% of the normal side, resulting in an excellent Modified Mayo Wrist score. Prolonged treatment with a spica cast immobilization resulted in scaphoid union and an excellent Modified Wrist score in all patients.

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A finite element comparison of superior versus anteroinferior plating of midshaft clavicle fractures

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Introduction: Plate positioning in reconstruction of a fractured clavicle remains controversial. Experimental biomechanics studies advise a superior placement, but clinical series report very low complications of mechanical nature for the anteroinferior positioning. There exist to date no information on the deformation and stress patterns induced by the plating of the clavicle.

Methods: To gain a more profound understanding of the biomechanical consequences of clavicle fixation, we performed a finite element simulation of the superior and anteroinferior reconstructions and compared the results to the intact clavicle. The loading modes (axial compression and cantilever bending with a load directed inferiorly) were chosen to replicate clinically relevant situations.

Results: In axial compression, the superior placement is less likely to fail, confirming previous experimental studies but only the anteroinferior placement led to a deformation mode similar to the intact bone. Further, in inferior bending, the anteroinferior placement was biomechanically preferable. In all cases, the portion of the plate bridging the two bony fragments was critical for the behavior of the whole construct.

Conclusion: Improvements in the resistance of the plate at the fracture site and special attention during surgery to obtain a good fixation around the fracture may reduce the complication rates due to failure of the plate and provide a stiffer construct. The biomechanical outcome of the reconstruction being highly dependant on the type of loading, no definitive recommendations can be made on placement of the reconstruction plate as long as in vivo loads acting on the clavicle remain unknown. However, under the assumption that axial compression is involved in fractures, superior placement of the reconstruction plate may be preferred for a patient at risk for fractures. For a reconstruction where the risk of fracture is lower but other factors such as aesthetics are important, anteroinferior plating may be favored.

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Compound osteosynthesis in a metastatic fracture of the radius

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Metastatic fractures of the radius are a rare entity and guidelines for operative treatment are not well established. We report about a patient suffering from a pathological fracture of the radius mid-shaft due to breast cancer with considerable bone defect and shortening of the radius. Consecutive ulnar impaction syndrome was very painful and pronation supination movement was not possible any more. To provide best construct durability, rotational stability and maximal pain relief we treated this patient with a compound osteosynthesis using a combination of extramedullary plate osteosynthesis and intramedullary multiple K-wire fixation reinforced by bone cement. With restoring the anatomical alignment we were able to treat the secondary ulnar impaction syndrome. The patient was almost painfree and a range of motion of pronation supination of 35-0-50° and wrist flexion extension of 40-0-45° was regained. For these reasons compound osteosynthesis in metastatic fractures of the radius is a good treatment option in palliative settings.

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In vitro primary stability of glenoid components in reverse total shoulder arthroplasty: improved methods and insights

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Introduction: Poor glenoid component stability is one of the major complications in reverse shoulder replacement. The purpose of this study was to compare the initial stability of two competing reverse glenoid component designs. We tested the Delta III, characterized by a flat back and 4 screw fixation and the Anatomical Inverse / Reverse prosthesis, which has a curved back and 2 screw fixation.

Methods: The standard *in vitro* method for glenoid implant testing was used. The glenoid components were implanted according to manufacturers' guidelines into Sawbone blocks mimicking trabecular bone density. A compressive load of 700 N and a vertical shear load of 700 N were applied for 1000 cycles, and micromotion between the baseplate and the sawbone was quantified by means of a

displacement gauge. In addition to the standard testing method, we performed a digital image analysis of micromotion at the implant/block interface using high resolution video cameras.

Results: With the displacement gauge, typically reported micromotions (above 100 microns) were measured. In contrast, no micromotion was detected using image analysis of the bone-baseplate interface for either prosthesis. Performing a comparison of these two methods, we could show that both measurement systems have a similar accuracy, but displacement gauges are heavily biased.

Conclusion: In contrast to previous reports, this study demonstrates that both tested prostheses designs were highly stable in standard in vitro biomechanical testing. Studies that assess motion of the baseplate using gauges instead of relative motions at the interface comprise elastic deformation of the whole system within the displacement measurements. This artefact can be avoided with a direct image analysis of relative motion between chosen points at the interface. Further, gauge measurements can characterize motion along one axis only, while image analysis allows assessing displacements in 2D (shear and rocking). Therefore, we strongly advise using digital imaging to appropriately measure micromotion, and recommend that new standards be developed for in vitro assessment of micromotion.

Intramuscular haematoma mimicking an acute rupture of the subscapularis tendon

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Introduction: The isolated rupture of the subscapularis tendon is a relatively rare but serious injury of the shoulder. Conservative treatment and late reconstruction often lead to poor clinical results. Therefore early suspicion, diagnosis and if possible reconstruction have been postulated. In case of a positive lift-off test, positive belly-press test and increased external rotation an isolated rupture of the subscapularis tendon is in all probability.

Case report: Two months after a direct contusion of her right shoulder a 59-year-old patient presented pain and significant deficiency in strength for active internal rotation as well as a positive lift-off and belly-press test in the clinical examination. The ultrasonography showed irregularities at the subscapularis tendon that were interpreted as a partial tear. To verify the suspected lesion we performed a MRI, which showed no pathologies of the tendon but a haematoma in the musculotendinous junction. After six weeks of conservative treatment we repeated the MRI. Then the haematoma had decreased in size and in correlation pain and deficiency of strength were regredient.

Conclusion: Intramuscular haematoma of the subscapularis muscle that in clinical and ultrasonic examination presents as an acute rupture of the subscapularis tendon is – to our knowledge – a new entity of shoulder injuries. Conservative treatment led to a good outcome in this single experience.

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Fracture dislocation of the shoulder associated to neurovascular lesions

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Introduction: Proximal humerus fractures are a frequent pathology observed in trauma centers. They represent about 5% of fractures treated in our hospital. Most of these fractures are minimally displaced and are treated conservatively. In rare cases of displaced fractures we find neurovascular lesions. We would like to present a case of fracture dislocation of the shoulder associated with entrapment of the axillary artery in the fracture and complete paralysis of the ulnar and radial nerve.

Case report: A 60 year old woman was transferred to our hospital from a private clinic with the diagnosis of a 3 part fracture dislocation of her shoulder (Image). The clinical exam revealed an absence of the radial and ulnar pulses together with a complete paralysis of her radial and ulnar nerves. Without trying any closed reduction manoeuvres, we took the patient to the OR and performed a deltopectoral approach of the shoulder. We discovered an incarceration of the axillary artery, just below its emergence from the brachial plexus (Image), in the fracture site. The fragments were distracted using a laminar spreader and the artery was freed. We observed immediate recovery of the radial pulse. After osteosynthesis of the fracture the patient underwent an angio CT scan (Image) to eliminate the possibility of vascular damage. Results of the CT scan showed a well permeated artery without any signs of intimal damage. Neurological symptoms persisted to date (3 weeks post op).

Conclusion: We have performed a review of the littérature on neurovascular damage associated to fractures of the proximal humerus and found 30 cases. This pathology remains rare. Surgeons

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should however always be suspicious of associated neurovascular lesions when treating proximal humerus fractures. We believe that in cases of fracture-dislocations with N-V lesions no attempt of reduction should be made by closed means in order to protect vessels and nerves from further damage. We would also like to stress the importance of complementary exams (angio-CT) in the evaluation of vascular pathology in such cases.

A rare case of a spontaneous hematogenous osteomyelitis of the acromion in a healthy 11 year old girl

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Introduction: Osteomyelitis is an infection in bone most frequently occurring in children. The majority of infections of bone or joint are caused by spread of bacteriae through the bloodstream or occasionally by entry of organisms through an open wound, by puncture or by extension of infection from adjacent tissue.

Methods: We report a case of a healthy 11 year old girl presenting with a short history of shoulder pain and stiffness in our outpatient department. MRI showed an edema of the subacromial bursa, the osseous structures were displayed without any visible pathologies. Clinical chemistry showed elevated inflammation parameters. We performed a shoulder arthroscopy under the suspicion of a bacterial arthritis, revealing no relevant intraarticular pathology. The shoulder pain persisted postoperatively and the girl developed a clear abscess formation around the acromion. The CT-Scan showed a rapid osseous destruction of the acromion. Subsequently revision surgery was performed, verifying a spontaneous hematogenous osteomyelitis of the acromion.

Results: After surgery and a short period of antibiotic treatment, the symptoms of the patient ceased completely. In the latest follow-up examination one year after surgery the girl is free of complaints, active and sporty. Radiological follow ups show extensive osseous destructions of the acromion. Nonetheless there is no clinical, radiological or chemical evidence of a persisting infection. There are no functional limits of the shoulder verifiable.

Conclusions: Arthroscopy is a low-invasive and safe method to establish and treat the diagnosis of a bacterial arthritis. Extensive osseous destructions of the acromion do not necessarily reflect pathological clinical findings concerning functional limits.

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Partial rupture of the triceps tendon, a case report with 12 week results and review of the literature

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A 49 year old male bodybuilder presented with a painful left elbow and limited motion. During an inclined benchpress exercise with short dumbbells he felt a sudden burst and pain about the left elbow with loss of strength. Two months before he suffered a direct trauma on both stretched elbows due to a fall. From the fall, it persisted a bursitis olecrani on both sides. In the clinical examination a swelling, tenderness and a bruise in the distal part of the triceps was found, no bump was palpable. The active Flexion/Extension range in the left elbow was 90-20-0 with reduced strength. Radiographically an avulsion of the olecranon with the typical flakesign was seen, and the sonography showed the suspected diagnosis of a partial rupture of the triceps tendon. The tendon repair followed two days later. Intraoperatively the partial rupture of the triceps-tendon was confirmed. The tendon was then reattached with a bunnell-like suture with two drilling holes through the olecranon with a fibre-wire. A splint in 90° angle in the elbow was applied after surgery. With physiotherapy the patient is allowed to passive motion with a limited range of 90-0-0. This poster presents the case report with 12 week results and a review of the literature.

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Intra-spinal balloon location as complication of balloon kyphoplasty

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Introduction: Kyphoplasty is acknowledged as effective treatment of osteoporotic vertebral fractures. The treatment is minimal invasive and may through erection and fixation of fractured vertebral bodies improve vertebral alignment while reducing pain. Complications of kyphoplasty encompasses cement dislocation in 4.8–39.0% cases. Further complications are rare with 2.5%. So far, no intra-spinal balloon location has been described.

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Case report: Following a three-month conservative treatment of a 77-old female patient, a CT scan showed a non-recent, formerly unstable TH6 fracture with a collapse of the anterior vertebral wall of app. 50% and a discrete collapse of the posterior vertebral wall edge of 3 mm with a small cranial fragment. Kyphoplasty was indicated because of pain. During the procedure a maximum pressure of 290 mm Hg was gauged after implementing the balloons on both sides with an applied balloon volume of 1–2 ml. The enlargement of the balloons was not shown in the intra-operative x-ray. The maximum pressure fell suddenly under 150 mm Hg at the right side. The x-ray demonstrates the balloon escape dorsal right into the spinal canal. 3 Monate nach konservativer Behandlung zeigte das CT bei einer 77-jährigen Patientin eine nicht frische, ehemals instabile BWK6 Fraktur mit deutlicher Sinterung der Vorderkante um ca. 50% und diskrete Sinterung der Hinterkante um 3 mm mit kleinem kranialen Fragment. Thus, the balloon is immediately deblocked and pulled out without suffering functionality. A prompt dorsal decompression revealed a fracture of the rear edge of the BWK6. No visual impairment of dura and spinal cord have been observed. Postoperatively, the patient presented no neurological deficits. 6 months later, the MRI indicates signs of a myelopathy.

Discussion: The intra-spinal balloon location is a seldom complication of the balloon kyphoplasty. Kyphoplasty increases in traumatic indications, therefore, a low morbidity and mortality rate for generally younger patients has to be demanded. In addition to a correct positioning of the working-canals and balloons, a preoperative CT is necessary for disclosing whether the posterior wall has been affected through the fracture. In spite of all precautionary measures, fracture of the posterior wall with an intra-spinal compression through kyphoplasty balloons is still a risk.

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Post operative epidural haematomas following spinal surgery

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Introduction: Compressive epidural haematomas occurring following spine surgery are very rare but can potentially lead to irreversible damage. The evacuation of the haematoma as an emergency procedure remains the only effective treatment providing though alerting signs are detected on time. Few studies exist on this subject probably due to its rarity. The etiological factors as well as the place of imaging studies prior to urgent haematoma evacuation remain controversial. Two cases of delayed post-operative compressive epidural haematomas following lumbar-spine surgery were detected in our unit between April 2003 and January 2009. In both cases new onset of pain, aggravation of existing neurological deficit or development of new deficit along with worsening of pre-existing walking difficulties were noted. Emergency computer tomography (CT) could not exclude compression in both cases due to important artefacts. Emergency surgery was performed confirming the presence of haematoma in both cases and leading to a complete neurological recovery following its evacuation. As only risk factors common to both cases we identified drain removal and resuming of thromboprophylaxis.

Conclusion: Obstacles in early detection of post-operative compressive epidural haematomas occurring following spine surgery are patients presenting with multiple complaints as well as shift work pattern of staff who might not always be trained in detecting early changes in neurological status. We therefore established a checklist for post-operative neurological observations to be carried out on spine surgery patients during the postoperative period. We describe our adopted attitude considering the etiological factors observed in our unit. Further studies including in a multi centre setting would be necessary in order to ascertain our observations.

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Percutaneous Vertebroplasty in sheep; Development of an animal model

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Study design: An experimental life animal study.

Objectives: To develop an animal model for percutaneous vertebroplasty under clinical conditions.

Summary of background data: Several studies described open techniques for cementation of sheep and goat vertebrae; no percutaneous technique has been developed to date for non-primates.

Methods: In a pilot study with dissected cadaveric ovine vertebrae the technique and instruments as well as optimal needle position were determined. In a life animal study 36 lumbar vertebrae of 12 sheep a bipedicular, percutaneous vertebroplasty under general anesthesia was performed and needle position and cement distribution was evaluated from Micro CT scans.

Results: The technique was applicable for all vertebrae without adverse effects for the animals related to the technique. The procedure

showed a steep learning curve represented by better needle positioning and shorter operation times with progression of the study. In average 3.2 ml (± 0.8) of PMMA could be injected into each vertebra.

Conclusions: The described technique is feasible, repeatable and safe under clinical conditions. This is the first percutaneous vertebroplasty technique for non-primates and we conclude, that the sheep is a valid animal model to investigate the effects of cement augmentation in vivo.

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Development and validation of a german version of the whiplash disability questionnaire (wdq) in acute and chronic whiplash associated disorder

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Introduction: For the management and investigation of whiplash-associated disorders (WAD) the use of patient oriented disability questionnaires are of uppermost importance. The Australian whiplash disability questionnaire (WDQ) is one such questionnaire with a high content, face and construct validity and an excellent short- and medium term reproducibility and responsiveness but until now no German version was available. We developed a cross-cultural adaptation of the WDQ for a German speaking population and ensured retention of psychometric properties such as validity and reliability of the translated version for acute and chronic settings.

Methods: The process of translation and cross-cultural adaptation was performed according to the AAOS guidelines. A total of 113 patients (75 acute and 38 chronic) and a control group of 177 asymptomatic volunteers completed the translated 13 item questionnaire as well as a visual analog scale for health (VAS_{health}) and a general disability questionnaire (EQ-5D) for comparison. All chronic patients completed the WDQ twice in an interval of 2 weeks for test-retest reliability assessment.

Results: Translation of the questionnaire was unproblematic. The translated version showed no floor or ceiling effects, a high internal consistency with a Cronbach's alpha of 0.95 and a very good inter-item correlation (overall MSA of 0.926). The concurrent validity testing using the VAS_{health} and EQ-5D as reference, showed a significant correlation of the WDQ to the EQ-5D and VAS_{health} both for the acute and chronic patients ($p < 0.0001$). The intraclass coefficient (ICC) for test-retest reliability was 0.95 indicating a high short term reproducibility.

Conclusion: We conclude that our German version as the English original of the whiplash disability score WDQ is valid and reliable and can be used as an outcome measure for studies with acute and chronic WAD patients.

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Accuracy of CT-based computer-navigated total hip arthroplasty

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The long-term results of a total hip arthroplasty (THA) strongly depend on the correct acetabular component positioning. Malorientation of the cup increases the risk of prosthetic impingement, dislocation, wear and can lead to early revision surgery. During the last decade, computer-assisted techniques have reached a level of broad clinical acceptance in orthopaedic surgery. The goal of navigated THA is to improve the orientation of the acetabular cup. The aim of this study was to measure the accuracy of CT-based computer-assisted THA in a large clinical series. Because the measurement of cup orientation on plain radiographs is highly inaccurate due to the individual pelvic orientation during radiograph acquisition a novel and validated 2D/3D-matching technique was used. This method allows matching the 3D-model of a CT with the projected pelvis on a radiograph and therefore measure cup orientation relative to the anterior pelvic plane. Cup orientation was measured using this technique in 304 hips that underwent CT-based computer-assisted THA between 2004 and 2008. According to the intraoperative value of the navigation system the cups were impacted at an orientation of 40.8 ± 1.3 (38 – 45) degrees of inclination and 29.1 ± 3.4 (23 – 38) degrees of anteversion. The postoperative measurements revealed an orientation of 44.1 ± 4.6 (31 – 52) degrees of inclination and 27.1 ± 6.2 (17 – 41) degrees of anteversion resulting in a mean error of 3.3 ± 4.7 (9 – 11) degrees for inclination and -2.0 ± 6.3 (12 – 9) degrees for anteversion. Of the total of 304 hips, 7 (2.3%) were placed outside the safe-zone according to Lewinnek and 2 (0.7%) dislocated postoperatively. This study showed that CT-based computer-navigated THA allows an exact positioning of the acetabular cup resulting in a very low dislocation rate.

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