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Abstracts



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FREIE MITTEILUNGEN / INDIVIDUAL COMMUNICATIONS

A01 – SHOULDER/ELBOW

Common extensor tendon avulsion mimicking tennis elbow: clinical and structural results following knotless anchor repair (9595)

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Introduction: Lateral epicondylitis or tennis elbow is one of the most frequent elbow disorders and in the majority of cases successfully treated non-operatively. In some cases an extensive tear of the common extensor tendon (CET) insertion may maintain chronic symptoms. This study documents the clinical and structural results following repair of the common extensor tendon insertion using a knotless anchor.

Methods: 20 patients with chronic lateral elbow pain and a MRI-proven high-grade CET tear were included in this study. All patients had undergone unsuccessful conservative treatment for at least 6 months before surgery. The surgical intervention included a diagnostic arthroscopy with removal of the posterolateral plica and an open repair of the CET. Mayo Elbow Performance Score (MEPS), quick Disabilities of the Arm, Shoulder and Hand Score (quickDASH), the patient-rated tennis elbow evaluation score (PRTEE) were obtained. Grip strength was measured with a hand dynamometer and compared to the contralateral side. Minimal follow-up time was 12 months. At final follow-up an ultrasound examination was performed to evaluate tendon healing. Adverse events which occurred throughout the period between operation and final follow-up were documented.

Results: 18 of 20 patients were available for clinical follow-up. One patient was satisfied with the result but too busy to participate and one patient was lost. The median follow-up time was 3.1 years (range 1-6.4). The mean age of the patients was 48 years (range 20-74). From baseline to follow-up the median MEPS significantly improved from 55 to 100 with the parameter for pain being reduced to no pain in 16 and to little pain in 2 patients. Median quickDASH and PRTEE at final follow-up were 5 and 2 points respectively. Median grip strength was 36kg (range 28-68) reaching 100% (range, 52 to 114) of contralateral side value. Ultrasound imaging showed an intact insertion in all cases but calcifications were noted in 5 individuals. All patients reported a satisfaction score of 7 or more on the numeric rating scale. One patient underwent ulnar nerve decompression 11 months following the procedure.

Conclusion: Repair of high-grade CET tears resulted in a high success rate for pain relief and patient satisfaction. Postrepair tendon integrity was confirmed by ultrasound. Repairing the CET tear may reduce the risk of iatrogenic posterolateral instability occurring with complete release.

Avoid injuries to the anconeus nerve. A revision of the topographical course (9699)

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Introduction: The anatomy of the anconeus nerve is clinically important because of the proximity of this nerve to most posterior elbow approaches and the importance of the anconeus muscle as a secondary elbow stabilator. The knowledge of its course is crucial to protect this nerve.

The aim of this study was to take a precise look on the Anconeus nerve, his origin and insertions of the muscular branches and to map the topographical course of this important branch of the radial nerve. We investigated these in detail in reference to clear anatomical landmarks, all of which can be palpated precertain with ease.

Methods: We performed an anatomical dissection in 15 fresh frozen elbows specimens. The radial nerve was followed distally until the anconeus nerves starts to detach from the radial nerve. This “apparent origin” was recorded in relation to the intercondylar line (ICL). The anconeus nerve was further traced distally up to its entry to the anconeus. A concomitant innervation or nerve branches to the medial head of triceps brachii were visualized and the diameter of the nerve was measured at its apparent origin and in his muscular insertion. The relation between the topographic course of nerve as regard of chosen landmarks (Tip of the olecranon, medial and lateral epicondyle) were assessed.

Results: The Anconeus nerve separated with an initial diameter of 1.5mm (SD: 0.2) from the radial nerve at about 16.4 cm (SD: 1.5cm) proximal to the lateral epicondyle, postero-medial of the humerus. The nerve run between the lateral and the medial head of the triceps, before entering the medial head ad an average of 10.2cm (SD: 2.4 cm) proximal to the intercondylar line (ICL) and running intramuscular until the distal humerus. Exiting the muscle for a short distance, the nerve lies on the periosteum of the distal humerus and the dorso-lateral articular capsule of the elbow joint, before entering the anconeus muscle with an average diameter of 0.5 mm (SD:0.1mm)

Two different types were found: 8 nerves innervate also the lateral head of the triceps and the other 7 nerves only contribute two branches to his innervation.

Conclusion: Upper extremity surgeons should, be aware of the course of the anconeus nerve, to avoid iatrogenic injuries to the nerve in posterior elbow approaches. We want to underscore the critical passage of the nerve on the periosteum and the articular joint capsule, between the medial head of the triceps and the insertion into the anconeus muscle.

1-year Treatment Effects for Rotator Cuff Repair in a Large Single Center Registry (9734)

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Introduction: The treatment effect (TE) is a method to measure the outcome for each treatment as number with patient questionnaires. TE = complaint reduction/baseline complaints. 1 is the best outcome and corresponds to a patient without symptoms. A positive score means amelioration, 0 staying unchanged and a negative score worsening. In this study, the TE's for rotator cuff repair were calculated in a large single center registry.

Methods: Included were all consecutive patients with rotator cuff lesions appropriate for arthroscopic rotator cuff repair. Excluded were those with large irreparable cuff lesions, revision, osteoarthritis, and/or polyarthritis. All patients had assessment with Quick Dash (3 questions for symptoms, 8 for impairments) preoperatively, after 3, 6 and 12 months. A physiotherapist measured abduction, external/internal rotation and abduction force.

All patients had primary rotator cuff repair in one clinic by one of two experienced shoulder surgeons and identical follow up treatment.

The treatment effects (TE) were calculated using the Quick Dash score normalized from 0 to 100. The TE's were divided in five qualitative outcome categories. Complete reduction after intervention: TE >0.95, >50% complaints reduced: TE >0.5 to 0.95, <50% reduced TE >0.2 to 0.5. Unchanged TE 0.2 to -0.2 and worse (more complaints >MCID) <-0.2.

Results: From 01/2011 to 12/2018, 621 patients had rotator cuff repair and complete data. Thereof were 254 women (41 %), the average age was 61.3 years (from 23 years to 84 years), and comorbidities (measured in ASA scores) were 26% ASA 1, 61% ASA 2, 13% ASA 3, no ASA 4.

The mean Quick Dash score reduced significantly from mean 42.28 (SD 17.8) preop to 8.9 points 12 months postop (SD 12.2) (p <0.001). The

TE's ranged from 1 to -2.31 (mean 0.77; SD 0.44). The five outcome categories were: 37% with complete reduction, 49% with reduction >50%, 8% with reduction <50%, 4% unchanged and 2% worse.

575 patients (= 94%) responded to treatment.

Mean range of abduction ameliorated from 118.0 (SD 41.1) to 149.8 (SD 15.5) degrees and mean abduction force augmented from 2.15 (SD 2.1) to 3.13 kg (SD 1.7); both significant ($p < 0.05$).

Conclusions: Outcome for rotator cuff repair can be measured as treatment effects with a patient questionnaire. 94% of the patients responded to treatment and had reduction of symptoms, regain of ROM and abduction force, only 6% of the patients had no or negative treatment effect.

Prediction Model For Functional Outcome after Repair Using Deep learning Method. A Pilot Study (9744)

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Introduction: The greatest triumph of surgery today...lies in finding ways for avoiding surgery. Artificial intelligence has the potential to guide treatment for orthopedic conditions such as arthroscopic rotator cuff repair (ARCR). The purpose of study was to evaluate the ability of machine learning to predict outcomes of after ARCR based on preoperative and intraoperative inputs.

Methods: 920 ARCRs with minimum 2 year follow up were analyzed from data prospectively collected data in a large database. Patient demographics, preoperative patient reported outcome measures, and intraoperative data were used to predict SANE scores at one and two years postoperative. The database was initially divided into training (89%) and testing (11%) subsets. Then, 20% of the training data was used as a validation set. Machine learning algorithms were used to generate predictive models with a minimum acceptable accuracy of 90%.

Results: Three different model (linear regression, decision tree and neural network) accuracies were 80%, 86% and 97% based on various inputs. The neural network model with patient demographics, age at treatment, Body Mass Index, smoker, diabetic, preoperative ASES scores, tear size, physical score, mental score, hand dominance and tendon retraction had a 97% accuracy for predicting postoperative SANE scores.

Conclusion: It is commonly said in the surgical field that it takes five years to learn when to operate and twenty years to learn when not to. Our study suggests that the second part of this quotation might not be relevant forever. Different algorithms have been refined to build an AI practical clinical model based on pre- and intraoperative data that predict efficiently rotator cuff outcomes. With an accuracy of 97%, the model is not a simple heuristic; it could be integrated into existing healthcare information systems to help clinicians develop better and more reasonable treatment programs and more adequately inform patients about expected results. Bigger set including objective and radiological data seem however necessary to obtain preoperative safer guidelines, patient's needs being unique and not simply aligned on SANE improvement thresholds.

Clinical results of dynamic anterior stabilization (DAS) with a minimum two-year follow-up (9745)

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Introduction: Chronic and recurrent anterior glenohumeral instability is a common pathology that preferentially affects young and athletic adults and usually results in degenerative arthropathy. The purpose of this study is to evaluate the short-term outcomes of the arthroscopic Dynamic Anterior Stabilization (DAS), which is a transfer of the intra-articular portion of the long head biceps through the subscapularis split and fixation on the anterior glenoid, combined with the Bankart repair.

Methods: We performed a retrospective study of 23 consecutive patients with a history of chronic or recurrent shoulder dislocations and a minimum of two-year follow-up. Exclusion criteria were glenoid bone

loss more than 20%. Out of 23 patients, one person was lost to follow-up and two people were revised with Latarjet procedure.

Results: During the study period 20 patients were treated for chronic anterior shoulder instability with arthroscopic Bankart repair and DAS with a minimum follow-up of two years. The average follow-up was 3.3 ± 0.5 years (median, 3.5; range, 2.3-4.2). There were 9 women and 11 men. Their average age was 31.2 ± 12.6 years (median, 29; range, 18-68). We noticed a statistically significant increase ($p < 0.001$) in Rowe score from preoperative 38.0 ± 15.6 to postoperative 95.5 ± 9.0. At the final follow-up, statistically significant differences were observed in shoulder anterior elevation ($p 0.005$) compared with the preoperative results. We noticed a trend of increase comparing the preoperative and postoperative external and internal rotation, however the difference was not statistically significant. Four patients presented signs of hyperlaxity, three practiced sport with armed type gestures, two in competition. Three patients presented with a recurrence.

Conclusions: The DAS procedure has been shown to be an effective treatment of chronic anterior shoulder instability with anterior glenoid bone loss smaller than 20%, while avoiding a deficit in shoulder range of motion.

Internal Rotation Hand in the Back After Reverse Shoulder Arthroplasty is Dependent of Subscapularis Tendon Healing, Scapular Tilt and Internal Rotation at 90° of Abduction (9747)

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Introduction: Recovery after RSA of internal rotation hand in the back (IR1) remains unpredictable. The present study aims to confirm the role of the subscapularis tendon and identify other factors such as scapulothoracic mobility (tilt) and/or IR at 90° of abduction (IR2). Our hypothesis was that recovery of IR is dependent of multiple factors.

Methods: 87 patients were included. The study focused on 3 predictive factors for IR recovery: subscapularis tendon healing (ultrasound-controlled; no ultrasound was performed when muscle fatty infiltration was ≥3); scapular tilt; IR2 in degrees. The same surgical technique and the same prosthesis were consistently used. The Constant scoring system was used, particularly for IR1 (10 points). Recovery of functional IR1 was also evaluated by dividing patients into 3 groups: type 1 with hand to buttock, type 2 with possible but unsmooth IR1, type 3 with complete IR1. Statistical analysis (uni- and multivariate) was performed by comparing Type 1 (unsatisfactory IR1) vs Types 2 and 3 (functional IR1).

Results: Subscapularis healing was successful in half cases. Constant score was 74% in patients with healed subscapularis vs 71 in non-healed subscapularis ($p < 0.05$). With a healed subscapularis, IR1 was better (7.2 vs 5.1 points, $p < 0.05$) and more patients had types 2 and 3 IR1 ($p = 0.003$). An increased IR2 was correlated to better IR1 ($p < 0.0001$). With regard to scapular tilt, no significant difference was observed, except when IR2 was <50° ($p = 0.0040$). When comparing type 1 and types 2 and 3, multivariate analysis found a highly significant difference (OR=1.10 [IC: 1.06-1.17]; $p < 0.0001$) for IR2; a significant difference for subscapularis healing (OR=5.14 [IC: 1.30-16.71]; $p = 0.002$), and a trend towards a significant difference for the tilt (OR=1.16 [IC: 1.03-1.32]; $p = 0.066$). The probability for better functional IR1 was multiplied by 1.16 for each additional degree in scapular tilt, by 1.10 for each additional degree of IR in position 2 and by 4.36 in case of subscapularis healing.

Conclusion: Subscapularis healing rate was low. The healing process was significantly associated with the recovery of functional IR1. Scapula tilt and IR2 play an important role and IR1 recovery is multifactorial. The present study classified IR1 recovery as functional or not functional. These results show that repairing subscapularis could also enhance IR1 recovery by acting on the 2 other factors.

Long Head of Biceps Tenotomy in Rotator Cuff Repair: Short term clinical outcomes after 1-year follow-up (9749)

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Introduction: The treatment of a pathological long head of biceps (LHB) in conjunction with arthroscopic rotator cuff repair surgery has been a matter of debate. Many favor tenotomy due to the simplicity of the procedure but others prefer tenodesis due to higher complications on performing tenotomy. Our study aims to highlight the outcome of patients undergoing LHB tenotomy in arthroscopic rotator cuff repair surgery focusing on the occurrence of Popeye sign and bicipital cramps. Our hypothesis is that patients who undergo the above procedure will have minimal pain and deformity following surgery with good functional outcomes.

Methods: A single center non-randomized prospective observational study was performed between May 2015 till June 2017 in all patients undergoing arthroscopic rotator cuff repair surgery. The long head of biceps was assessed on all these patients intra-operatively and those with non-pathological LHB were excluded. Important demographic data including the patient's body mass index (BMI) and work level were also collected. Postoperatively, patients were observed for the occurrence of Popeye sign and bicipital cramps at 6 months and 1 year follow up. Patients with Popeye sign and bicipital cramps were compared with the ones without and evaluated in terms of pain, shoulder subjective value (SSV) score, and Constant score.

Results: A total of 208 patients were included in our study with a mean age of 61 and a mean BMI of 27.5. 38 patients developed Popeye sign (18.3%) at 6 months follow-up, and it remained the same at 1 year. There was no significant difference in terms of mean VAS, Subjective Shoulder value (SSV) score, and Constant score when compared with the group with no Popeye sign. 50% of patients with Popeye sign were heavy labor workers. Bicipital cramps were observed in 15 patients (7.2%) at 6 months follow up, and it increased to 17 patients (8.2%) at 1 year. The mean SSV score, Constant score and pain score in these patients were significantly higher at 6 months and 1-year follow-up. Majority of patients with bicipital cramps were heavy labor workers (80%).

Conclusion: Occurrence of Popeye sign and bicipital cramps in patients following LHB tenotomy is fairly low. However, the majority of patients who perform heavy labor work have a higher chance of developing bicipital cramps, which have a poorer functional outcome.

Does Computerized CT-based 3D Planning Of The Humeral Head Cut Help To Restore The Anatomy Of The Proximal Humerus After Stemless Total Shoulder Arthroplasty? (9770)

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BACKGROUND: Restoration of proximal humeral anatomy (RPHA) after total shoulder arthroplasty (TSA) has been shown to result in better clinical outcomes than is the case in non-anatomical humeral reconstruction. Preoperative virtual planning has mainly focused on glenoid component placement. Such planning also has the potential to improve anatomical positioning of the humeral head by more accurately guiding of the humeral head cut, and selection of anatomical humeral component sizing. Hypothesis of the study: The use of preoperative 3D planning helps to reliably achieve RPHA after stemless TSA.

METHODS: 100 consecutive stemless TSA (67 males, 51 right shoulder, mean age of 62 ± 9.4 years) were radiographically assessed using pre- and postoperative standardized AP radiographs. The RPHA was measured with the so-called circle method described by Youderian et al. We measured deviation from the pre-morbid center of rotation (COR), and more than 3mm was considered as minimal clinical important difference. Additionally, pre- and postoperative humeral head diameter (HHD), head neck angle (HNA) and humeral head height (HHH) were measured to assess additional geometrical risk factors for poor RPHA.

RESULTS: The mean distance from of the pre-morbid to the implanted head COR was 4.3mm ± 3.1mm. Thirty five shoulders (35%) showed a deviation of less than 3mm (mean 1.9, ±1.1) and 65 shoulders (65%) a deviation of ≥ 3mm (mean 8.0 ± 3.7). Overstuffing was the main reason for poor RPHA (88%). The level of the humeral head cut was responsible for overstuffing in the 46 of the 57 overstuffing cases. The preoperative HHD, HHH and the HNA were significantly larger, higher and more in

valgus angulation in the group with accurate compared to the group with poor RPHA (HHD of 61.1mm ±4.4 vs 55.9 ±6.6, p <0.001; HHH 8.6±2.2 vs 7.6 ± 2.6 p=0.026, varus angulation of 134.7° ± 6.4° vs. 131.0° ±7.91, p=0.010).

CONCLUSION: Restoration of proximal humeral anatomy after stemless TSA using CT-based 3D planning was not precise. A poorly performed humeral head cut was the main reason for overstuffing which was seen in 88% of the cases with inaccurate RPHA. Preoperative small HHD, low HHH and varus angulated HNA are risk factors for poor RPHA after stemless TSA.

While Preoperative CT-based 3-D planning gives insight into the proximal humeral anatomy, execution of this insight through visual based surgery without guides or navigation, does not appear to increase accuracy of RPHA.

Speed of Recovery of the Most Common Performed Shoulder Surgeries (9771)

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BACKGROUND: Shoulder surgery results in several months of rehabilitation, which is often underestimated by patients preoperatively. Currently, there is little written about this process of recovery. Such information would help patients to anticipate the trajectory of their recovery. This would also provide a reference point allowing surgeons to compare patient's progress in their recovery. The purpose of our study was to analyze and document the expected rate of recovery for the most common shoulder operations.

METHODS: A retrospective analysis of all patients who underwent Total Shoulder Arthroplasty (TSA), Reverse Total Shoulder Arthroplasty (RTSA), Arthroscopic Rotator Cuff Repair (ARCR) and arthroscopic Biceps Tenodesis (BT) using our prospectively collected data from our surgical outcome system (SOS) registry was performed. All patients included had a complete 2 year follow up data set. The pain score (VAS) was measured preoperatively, at 2, 6, 12 weeks and 6, 12, 24 months. The ASES and SANE score were recorded preoperatively, after 6, 12 and 24 months. The speed of recovery, which was defined as percentage of the total improvement, for each procedure was assessed as the primary outcome parameter at all time points.

RESULTS: All shoulder interventions resulted in significant improvement of the pain, SANE and ASES score two years after shoulder surgery. The speed of recovery of all three scores was highest after TSA at all measured time points and slowest after ARCR and BT. Measured by the pain score, 90% and 82% of the total improvement after TSA and RTSA was completed after 6 weeks compared to 58% respectively 59% after ARCR and BT. Six months postoperative the ASES recovery rate was significantly higher after arthroplasty (TSA 96% and 85%) compared to ARCR and BT (76% and 77%). The SANE score recovery rate was between 82% and 92% (TSA 92%, RTSA 89%, ARCR 87%, BT 82%) 6 months after surgery. After 1 year all patients group reached 89% or more percent of total improvement in all scores, except of the pain after ARCR (89%).

CONCLUSION: The speed of early recovery is fastest after TSA and slowest after arthroscopic rotator cuff repair and biceps tenodesis. After TSA and RTSA, >80% of the total pain reduction is achieved 6 weeks postoperatively, whereas after ARCR and BT, >80% of the pain reduction is achieved only 6 months postoperatively. At 6 months postoperatively, the differences in recovery curves are small and hardly noticeable at 12 months.

Mid-Term Results of Arthroscopically-Assisted Latissimus Dorsi Transfer for Irreparable Posterosuperior Rotator Cuff Tears (9776)

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Introduction: With the progress in arthroscopic surgery, latissimus dorsi transfer (LDT) for irreparable posterosuperior rotator cuff tears (RCTs)

has become a reliable all-arthroscopic or arthroscopically-assisted procedure. Mid-term results of the arthroscopically-assisted LDT (aLDT) are scarce in literature. The purpose of this study was to report our clinical and radiographic mid-term results of aLDT for irreparable posterolateral RCTs.

Methods: Thirty-one consecutive patients with a mean age of 55.5 (Range, 38-73) years at the time of aLDT were evaluated after a mean of 3.5 (range, 2-5) years. All patients had irreparable, full-thickness tears of at least the complete supraspinatus +/- infraspinatus tendons and 14 patients (45%) had undergone previous rotator cuff repair. Seven patients (23%) needed a concomitant upper-third subscapularis repair at the time of aLDT. Mid-term results were assessed clinically and radiographically.

Results: At final follow-up, four failures (14%) had undergone revision to reverse total shoulder arthroplasty (RTSA) for untreatable pain. Patients revised to RTSA, had significantly higher preoperative pain levels (Constant pain scores: 6 points vs. 11 points; $p=0.032$) and lower Constant Score (CS) activity scores (2 points vs. 5 points; $p=0.017$) than the remaining 27 patients. Patients with failed previous rotator cuff repairs had significantly inferior results than patients without previous repair (mean SSV% 66 vs 88; $p = 0.035$) For the 27 non-revised patients, the mean relative CS improved from 63% to 76% ($p=0.032$), Constant pain scores from 10.5 to 12.7 ($p=0.012$) points and the Subjective Shoulder Value from 43% to 77% ($p <0.001$). Significant progression of glenohumeral arthropathy by two or more grades according to Hamada was observed in thirteen (48%) out of the 27 patients, but there was no significant difference in clinical outcome between the patients with ($n=13$) and those without arthropathy ($n=14$; $p=0.923$).

Conclusions: Mid-term results of the arthroscopically-assisted latissimus dorsi transfer for irreparable posterolateral RCTs is associated with significant improvement in objective and subjective outcome measures. The failure rate leading to conversion to RTSA is relatively high in this cohort. The failures were associated with unusually intense pain in low demand individuals and / or revision of failed rotator cuff repair.

Is it worth the risk? Clinical and radiographic outcomes 2 years after implantation of reverse shoulder arthroplasty in an advanced geriatric population (9780)

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Introduction: Reverse shoulder arthroplasty (RSA) has been on the rise in the past decades and showed excellent long-term outcomes. The indications for RSA were successively extended to a broader age spectrum. The objective of this study was to identify the benefits of RSA surgery in an advanced geriatric population with a considerable comorbidity burden and an affiliated higher perioperative risk.

Methods: In this observational study, based on our local RSA registry, we identified 42 patients (73.8% females) with a minimum age of 85 years (age range 85-91 years) at time of surgery and a completed post-operative follow-up at 2 years. Clinical evaluation consisted of pain, Subjective Shoulder Value (SSV), Constant Score (CS), Shoulder Pain and Disability Index (SPADI) and patient satisfaction. Radiographic evaluation followed the international consensus core-set. Pre-existing medical conditions were categorized following the American Society of Anesthesiologists (ASA)-categories: ASA II (23.8%) with minor and ASA III (76.2%) with major co-morbidities. Indications for surgery were rotator cuff deficiency in 78.6%, posttraumatic conditions in 16.7% and primary arthritis in 4.8% of the cases.

Results: All postoperative clinical evaluations showed a significant improvement 2 years after RSA implantation. Pain [0-10] decreased from 6.1 (SD 2.4) to 2.0 (SD 2.7) ($p <0.001$). Clinical scores improved likewise: CS from 23.6 (SD 2.4) to 60.9 points (SD 13.6), SSV from 36.3% (SD 19.7) to 67.4% (SD 25.9) and SPADI from 28.7 (SD 19.5) auf 71.2 points (SD 22.6), ($p <0.001$). 87.5% of patients stated to opt in favor of the surgery again, judging by their personal outcome. On a scale from 0-10 (10=highest), patients rated their satisfaction considering their preoperative expectations and their actual result with a mean of 8.3 points (SD

2.8). Radiographic evaluation showed no signs of early loosening, migration or dislocation after 2 years. Two periprosthetic spina scapulae fractures were identified and treated non-operatively.

Conclusions: Despite their advanced age and the typical numerous comorbidities, this patient population over 85 years of age showed a distinct clinical improvement for their daily activities with high rates of patient satisfaction. Radiographical analysis identified stable results 2 years after surgery.

Muscle edema of retraction and pseudofatty infiltration after traumatic rotator cuff tears (9792)

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Introduction: Traumatic rotator's cuff's tear leads to retraction, which can be visualized on MRI. Additionally, it could also result in edematous lesions of the cuff's muscles and pseudo fatty infiltration (FI), which further evolution through time has not been described in the current literature. The aim of this study was 1) to confirm the existence of a new type of edema (of retraction), 2) to reveal a related potential pseudoFI, and 3) to describe the timeline of development of rotator cuff muscle edema.

Methods: We conducted in parallel two studies: a basic science study on 14 sheep to confirm the existence of muscle edema and pseudoFI, and a retrospective study of 62 prospectively identified human with a traumatic rotator cuff tear associated to muscle edema. Our cohort consisted of 49 men (79%) and 13 women (21%) with an average age of 65 years. The average time gap between the trauma and the MRI was 46 days.

Results: First, the animal study confirmed that traumatic edema of retraction exists and can be mixed up with FI on T1 sequences. Second, we observed on human MRI that 52 patients (87%) had supraspinatus (SS) retraction; 6 (12%) had a stage 1, 25 (48%) stage 2 and 21 (40%) stage 3 retraction. Infraspinatus (IS) retraction has been observed in 33 patients (50%); 5 (15.2%) had stage 1, 16 (48.5%) stage 2 and 12 (36.4%) stage 3 retraction. Subscapularis (SSc) edema has been seen in 49 patients (79%), 30 patients (61%) had peripheral edema, 5 (10%) musculotendinous edema, 11 (22%) muscle body edema and 3 (6%) had a global SSc edema. Comparison between T1 and T2 FS/DIXON sequences of the MRI showed in 54 patients (87%) hypersignal which could be either FI or pseudo FI of the muscle. A positive tangent sign has been observed in only one patient (2%).

Conclusion: This study revealed a new type of edema of retraction that can appear already after few hours following a trauma. This edema has different characteristics, delay and location compared to edema of denervation. Such edema could theoretically explain muscle fibers dissections as well as rapid development of FI observed after trauma. This edema is associated with hypersignal on T1 sequences that can be mistaken with FI. All these findings are important regarding diagnosis, treatment and have legal implication notably to defend patients against insurances.

BiPOD Arthroscopically Assisted Bidirectional Stabilisation Technique for Acromioclavicular Joint Injury: Two-Year Clinical and Radiological Outcomes (9816)

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Introduction: The purpose of this study was to evaluate the intermediate-term clinical and radiological outcomes for acute, unstable acromioclavicular joint (ACJ) injuries treated with the arthroscopically assisted BiPOD stabilisation technique.

Methods: Twenty-three patients who sustained acute, unstable ACJ injuries were included in this prospective study. We recorded demographics, injury classification, time to surgery, clinical scores, radiological outcomes and complications; each patient completed a minimum of 2 years post-operative observation.

Results: Mean follow-up was 26 months (range, 24 – 34). Clinical outcomes scores demonstrated extremely good two-year results: relative Constant score, 97.9/100; ACJ Index, 89.4/100; Subjective Shoulder Value, 92.4/100 and Taft Score 11.1/12. Final CC difference compared to the contralateral side showed a mean of 0.7 mm (SD +/- 1.8 mm) at two years. Complication rate was 9%.

Conclusion: The BiPOD technique shows excellent intermediate-term results and low complication rate. We recommend use of this technique for stabilisation of all acute, unstable ACJ injuries.

Is Routine Shoulder Magnetic Resonance Imaging Necessary for the Diagnosis of Adhesive Capsulitis of the Shoulder? (9829)

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Introduction: Adhesive capsulitis (AC) of the shoulder is a debilitating condition with a high socioeconomic burden affecting up to 5% of the general population [1, 2]. The diagnosis of AC might be challenging, as it is a diagnosis of exclusion, and it is based mainly on the clinical examination [3]. Although shoulder MRI is commonly performed in patients with AC, the cost-effectiveness of MRI in AC diagnosis is not yet justified. Therefore, the purpose of the present study was to report the validity of MRI in terms of identifying an additional shoulder pathology in AC patients not previously recognized in the clinical examination and any change in the treatment based on the MRI findings.

Materials and Methods: The medical records of all the patients presented in our outpatient clinic with a diagnosis of AC from January 2017 to December 2017 were retrospectively reviewed. Patient demographics, the number of patients with a shoulder MRI, the diagnosis on the first medical report, changes in the diagnosis or identification of other shoulder pathologies following the shoulder MRI (if performed), and changes in the suggested treatment plan (physiotherapy, intraarticular shoulder injection, NSAR) were recorded.

Results: A total of 325 patients diagnosed with an AC (Male: 159, Female: 166) and an average age of 50±10 (range: 18 to 81) years were identified. In 211/325 patients (65%), a shoulder MRI was performed. The diagnosis of AC changed in 0/325 (0%) patients, whereas additional shoulder pathologies were identified in 33/325 (10%) patients, following the shoulder MRI, mostly rotator cuff tears (partial: 20/33 (61%), trans-mural: 9/33 (27%), re-rupture following reconstruction: 3/33 (9%) and labrum tear: 1/33 (3%)). No change in the suggested treatment plan was observed, and no surgery was performed to address the other shoulder pathologies at the minimum follow-up of 2 years. The total cost of the MRIs performed in the patients with AC was 253.200 CHF in 2017 in our institution.

Conclusions: The present study results suggest that the lack of cost-effectiveness of MRI in the diagnosis of the AC does not justify routine magnet resonance imaging should therefore only be considered based on clinical suspicion of additional shoulder pathologies.

Structural Musculotendinous Parameters Predicting Failed Tendon Healing after Rotator Cuff Repair (9844)

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Background: Healing of the rotator cuff after repair constitutes a major clinical challenge with reported high failure rates (13-94%). Identifying structural musculotendinous predictors for unhealed rotator cuff repair could enable improved diagnosis and management of patients with rotator cuff disease.

Purpose: To investigate structural predictors of the musculotendinous unit for failed tendon healing after rotator cuff repair.

Study design: Cohort study, level of evidence 3.

Methods: Predictors were evaluated in an arthroscopic rotator cuff reconstruction cohort. Biopsies were taken intraoperatively, and clinical and radiological assessment was performed pre-operatively, 3 months postoperatively and 12 months postoperatively. Structural parameters of musculotendinous unit were assessed using DIXON-MR-Arthrography and histology.

Results: In addition to known independent predictor age ($p = 0.009$, 95% CI = 1.03 – 1.26), supraspinatus tendon length ($p = 0.006$, 95% CI = 0.79 – 0.96) and hybride muscle fiber type ($p = 0.003$, 95% CI 1.07 – 1.43) showed a significant association with failed tendon repair in the multivariate analysis. Furthermore, Subgroup analysis of the predictive value of decreased tendon length stratified for age, tears size, fatty infiltration and hybride fiber type using ROC-curve cut-off values, showed that the area under the curve (AUC) increased from acceptable discrimination in the cohort (AUC 0.71) to excellent discrimination within tears size <2.5 (AUC 0.86), fatty infiltration <4.5 (AUC 0.81) and hybride fiber type <0.75% (AUC 0.80). Finally, tear chronicity showed a significant clinically relevant negative association ($p=0.001$, -18.06 points on the Constant Score, 95% CI = -28.55 – -7.56) with clinical improvement (Δ Constant score T12 months -T0).

Conclusion: Structural parameters of the musculotendinous unit could be identified as predictors for failed healing after rotator cuff repair. Both decreased tendon length and increased hybride muscle fiber type showed to be independent predictors for retear. Subgroup analysis using ROC-curve indicated that decreased tendon length is especially sensitive and specific for predicting retear in patients with small tear size, less fatty infiltration and less hybride type muscle fibers. Only chronicity of the tear seems to have a clinically relevant negative effect on the clinical outcome.

Biomechanics of Massive Rotator Cuff Tear Patterns (9848)

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Introduction: Understanding the biomechanics of massive rotator cuff tears (MRCT) helps to understand important compensatory muscles and how this compensation fails in certain cases such as pseudoparalyse. The biomechanics of MRCT can be studied using musculoskeletal modelling where muscle and joint forces are simulated for a given motion. To the best of our knowledge, no research has been undertaken to simulate the deltoid activity under different MRCT types.

The aim of this study is to apply musculoskeletal modeling for arm elevation from 0° to 120° to investigate the changes in deltoid activity based on simulations of different MRCT types.

Methods: Musculoskeletal simulations were performed in Anybody 7.3 based on repository AMMR v.2.3.1. The glenohumeral joint allows for rotations but no translations. The kinematics of scapula, clavicle and humerus are coupled based on a predefined shoulder rhythm. Arm elevation from 0° to 120° is simulated in the coronal, scapular and sagittal plane. Different MRCT types according to Collin classification were modeled by a prescribed inactivity of the respective RC muscle groups and the resultant activities in the deltoid and RC muscles were compared to a healthy control. The muscle activity is defined as the force exerted by the muscle normalized to its maximum isometric strength.

Results: An MRCT involving the supraspinatus and infraspinatus (type D) leads to a significant activity increase in the teres minor. If the teres minor is also torn (type E), the model compensates with a 55% activity increase in the posterior deltoid compared to the healthy case during abduction. Arm elevation in the sagittal and coronal plane lead to deltoid overactivation for MRCT type E.

Lost function in the supraspinatus and subscapularis are primarily compensated by the anterior and lateral deltoid, however, differences to the healthy control are small. An additional inactivity of the biceps brachii caput longum due to an assumed medial migration of the proximal tendon in case of a full thickness subscapularis tear (type B) leads to an increase in lateral deltoid activity by 32% for arm elevation in the scapular plane.

Conclusion: The biomechanical analysis may provide an explanation why patients with MRCT type B and E experience a high incidence of pseudoparalyse. Besides, the significant increase in teres minor activity for patients with an MRCT type D accords well with previous observations of teres minor hypertrophy.

Uncemented vs. cemented reverse total shoulder arthroplasty for primary treatment of proximal humerus fractures in elderly – A case-control study (9859)

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Introduction: We started uncemented RTSA for primary treatment of PHF in elderly patients in 2017 to simplify primary and eventual revision surgery. However, recent reports raised concerns about early bone resorption at the proximal humerus. Thus, it was the aim of this study to find whether there was a difference in functional or radiographic outcomes between cemented and uncemented RTSA in such patients.

Methods: In 2017 and 2018, 17 consecutive patients underwent uncemented RTSA (group nC) for the primary treatment of a PHF and completed clinical and radiographic follow-up at 2 years. For case-control comparison, we could include 34 age and sex matched (propensity score matching 1:2) patients who underwent cemented RTSA for the same indication between 2011 – 2016, and had completed 2-years follow-up examination as well (group C). The two groups were compared in terms of clinical (Constant score) and radiographic (greater tuberosity healing, implant loosening, bone resorption) outcome at 2 years after the index procedure.

Results: Group nC included 12 female and 5 male (mean age 74.1 (58.0 – 89.9)) and group C 30 female and 4 male (mean age 74.5 (64.1 – 83.8)). The mean deltoid tuberosity index (DTI) was 1.41 (1.20 – 1.70) in group nC and 1.42 (1.21-1.73) in group C. At final 2 year follow-up, the relative Constant score was 98% (71 – 118) in group nC and 97% (36 – 125) in group C ($p = 0.85$). The greater tuberosity healed in anatomic position in 77% in group nC and in 79% in group C ($p = 1.0$). No sign of loosening was seen in group nC whereas 8 (24%) patients in group C had some radiolucent lines at the cement-bone interface of the humeral site ($p = 0.58$). On the other hand, all but one patients in group nC showed at least grade 1 (50% grade 3) bone resorption at the proximal humerus ($p < 0.001$). The complication and revision rate was low in both groups. One patient in group nC and 2 patients in group C needed revision surgery.

Conclusion: Uncemented and cemented RTSA for PHF in elderly osteoporotic patients lead to excellent functional results with low complication and revision rate after 2 years. Bone resorption at the proximal humerus after uncemented RTSA was frequent and not clinically relevant but may complicate future revision surgery. This effect has been described as “stress shielding” analog to the hip but is not yet fully understood at the proximal humerus. Longer follow-up is needed to understand the relevance of this radiographic phenom

Results after revision arthroscopic rotator cuff repair – a prospective multi-center study on 100 cases (9875)

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Introduction: Primary arthroscopic rotator cuff repair has shown to provide reliable clinical results with a low re-tear rate depending on tear morphology and surgical technique. Rotator cuff re-tears following surgical repair are associated with poor shoulder function and unsatisfactory clinical results. Profound clinical data regarding the role of revision arthroscopic rotator cuff repair (RARCR) are sparse thus far. Hence, this study aimed to investigate the clinical and radiological results following RARCR. It was hypothesized that (1) RARCR would lead to an improved clinical outcome and that (2) the clinical results would be dependent on tendon integrity at two years.

Methods: During a period of three years, 100 patients who underwent RARCR were prospectively enrolled in this multi-center study of ten shoulder centers. Clinical results were evaluated pre-operatively, at six months and at two years by the Constant Score (CS), the Oxford Shoulder

Score (OSS) and the Subjective Shoulder Value (SSV). Tendon integrity was analyzed by magnetic resonance imaging at two years using the Sugaya classification. 13 patients (13%) were lost to follow-up (Table 1).

Results: All clinical scores improved significantly during the study period (CS from 44 ± 16 preoperatively to 58 ± 22 at six months to 69 ± 19 points at two years; OSS from 27 ± 8 preoperatively to 36 ± 11 at six months to 40 ± 9 points at two years; SSV from $43 \pm 18\%$ preoperatively to $66 \pm 24\%$ at six months to $75 \pm 22\%$ at two years; $p < .01$). At two years, a re-tear rate of 51.7% and a surgical revision rate of 12.6% were observed. While the Sugaya score improved from 4.5 ± 0.9 preoperatively to 3.7 ± 1.4 at two years, tendon integrity could not be correlated with better outcome scores. Prior open rotator cuff repair, involvement of the subscapularis tendon and medial cuff failure were correlated with poorer SSV scores at two years ($p < .05$).

Conclusion: While RARCR leads to an improved clinical outcome, re-tears are frequently observed at a mid-term follow-up. Patients with re-tears, however, do not necessarily have poorer shoulder function than those with healed tendons. Subjective patient satisfaction was lower when the primary surgery was performed by an open technique, when an associated lesion of the subscapularis was present and when the rotator cuff re-tear was located at the musculotendinous junction rather than at the footprint.

Conservative treatment of Rockwood type III acromioclavicular joint dislocation with two different types of braces: a comparative prospective randomized trial (9894)

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Introduction: Management of acromioclavicular joint dislocations (ACJD) is discussed controversially with low-grade injuries (Rockwood I-II) commonly treated conservative and high-grade (Rockwood IV-VI) operative, but there is an ongoing debate about the treatment of Rockwood III injuries, with non-operative treatment being favoured in recent literature. The aim of this study is to compare clinical and radiological outcomes of non-operative treatment with a brace, which elicits a direct reduction force to the lateral clavicle, to a sling. We hypothesised the brace might yield in better ACJ reduction and cosmesis.

Methods: In this dual centre prospective randomized controlled trial, all patients sustaining a ACJD Rockwood III between July 2017 and August 2020 were included. Patients with previous ipsi- or contralateral ACJ injury or surgery were excluded. Randomisation occurred in the emergency department to either the sling or the brace group. Patients were followed up at 1, 6 and 12 weeks. Patient reported outcome measurements included subjective shoulder value (SSV) and American Shoulder and Elbow score (ASES) at each follow-up and Constant score at 6 and 12 weeks. Vertical lateral clavicle displacement was assessed on bilateral panoramic anteroposterior radiographs using coracoclavicular (CC) distance to calculate the CC-index.

Results: 35 consecutive patients were included across the two sites, 18 (all male) in the brace and 17 (14 male) in the sling group. Baseline characteristics did not differ significantly between groups, average age was 40 years and BMI 25.5 kg/m². Analysis revealed no statistical difference in CC-index between groups at time of injury, 6 weeks and 12 weeks post-injury ($p=0.39$, $p=0.11$ and $p=0.21$). SSV improved from 30 and 35 post-injury to 81 and 84 at 12 weeks in the sling and brace group, respectively ($p=0.59$). ASES improved from 48 and 38 to 82 and 83, respectively ($p=0.84$). Similarly, Constant score improved from 64 and 67 to 82 and 81, respectively ($p=0.90$). One patient in the brace group underwent ACJ stabilisation with hamstring autograft at four months due to persistent pain.

Conclusion: This randomised controlled trial shows no statistically significant difference between the brace and sling group in clinical (SSV, ASES, Constant Score) or radiological (CC-index) outcomes after conservative treatment of Rockwood III injuries.

Lengthening of the clavicle, a new technique in patients with a brachial plexus birth palsy. (9897)

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Introduction: Brachial plexus birth palsy (BPBP) can lead to an imbalance of shoulder musculature with glenohumeral contractures and osseous deformities. Besides hypoplasia of the scapula and shortening of the clavicle, also protraction, lateralization and elevation of the scapula can be observed. As a consequence, the Trapezius, Levator Scapulae and Supraspinatus muscles are overloaded which can lead to pain. It is hypothesized that lengthening of the clavicle, may reposition the scapula to the best approached anatomical position. This study presents the initial results of this technique in BPBP patients.

Methods: 8 patients (median age 19.5 years) were included and underwent a z-lengthening osteotomy of the clavicle of the affected shoulder. Preoperatively the osseous deformities were confirmed with a CT-scan. PROMs, DASH-Scores and Mallet-Scores and Range of Motion (ROM) were evaluated pre- and postoperatively.

(Preliminary) Results: After 3.5 years follow-up, all patients were satisfied with the result and would undergo the operation again. The median VAS for satisfaction was 9.0 (range 7 – 10). Pain reduced to a median NRS of 1.5 (range 0 – 5). However, shoulder function, measured by Mallet-Scores, DASH-Scores and ROM did not improve.

Conclusion: Short term results show that, in BPBP patients with a malposition of the scapula, lengthening of the clavicle is a promising technique to reduce pain based on overloading, without affecting shoulder function.

Augmented Reality through Head-Mounted Display for Navigation of baseplate component placement in Reverse Total Shoulder Arthroplasty – a cadaveric study (9900)

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Background: To achieve optimal clinical outcome in Reverse Total Shoulder Arthroplasty (RTSA), accurate placement of the components is essential. The recently introduced navigation technology of augmented reality (AR) through head-mounted displays (HMD) offers a promising new approach to visualize the anatomy and navigate component positioning in a variety of orthopedic surgeries. We hypothesized that AR through HMD is feasible, reliable, and accurate for guidewire placement in RSA baseplate positioning.

Methods: Twelve human cadaver shoulders were scanned with computed tomography (CT) and RTSA baseplate positioning was 3-D planned using dedicated software. The shoulders were prepared through a deltopectoral approach and an augmented reality hologram was superimposed using the head-mounted display Microsoft HoloLens. The central guidewire was then navigated through the head-mounted display to achieve the planned entry point and trajectory. Postoperatively, the shoulders were CT-scanned a second time and the deviation from the planning was calculated.

Results: The mean deviation of the entry point was 3.5 mm +/- 1.7 mm (95% CI 2.4 mm; 4.6 mm). The mean deviation of the planned trajectory was 3.8° +/- 1.7° (95% CI 2.6°; 4.9°).

Conclusion: Augmented reality seems to be feasible and reliable for baseplate guidewire positioning in reverse total shoulder arthroplasty. The achieved values were accurate.

Keywords: Reverse Total Shoulder Arthroplasty; Augmented Reality; Head-Mounted Display; Navigation; Experimental; Cadaveric; Orthopedic Surgery

Complications and Reinterventions in Reverse Total Shoulder Arthroplasty: Report of 854 primary cases. (9901)

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Introduction: Complications and reinterventions following reverse total shoulder arthroplasty (RTSA) impair life quality for the patient. The aim of this study was to report the incidence of implant-related complications and reintervention surgeries in our prospectively followed cohort of primary reverse total shoulder arthroplasties.

Methods: The prospectively collected clinical and radiographic data of 854 patients with primary implantation of a RTSA between January 2005 and August 2018 were analyzed. The complication and reintervention rates were evaluated. Complications, contrary to problems, were defined to affect the outcome negatively. Reinterventions are defined as all necessary surgeries, which include reoperations (without component change) and partial or total revision of the implants.

Results: A total postoperative, surgical-site complication rate of 22% (188 complications) in 18% (156 out of 854) of the shoulders was documented after a mean of 46 +/- 35 (range, 0 to 169) months. The most common complications were acromial fractures (5.3%), glenoidal loosening or dislocations (4.3%), RTSA instability (2.7%), humeral fracture or loosening (2.5%), and periprosthetic infection (1.6%). 135 reinterventions were performed in 82 shoulders (10%). The most common causes for reintervention were glenoidal complications (24%), instability (15%), acromial fractures (14%), unclear pain / scarring (14%), and infection (9%).

Conclusion: Although indication and implantation rates are continuously increasing, RTSA remains a high demanding surgical procedure. Roughly 1 out of 5 patients undergoing RTSA might face a complication and 1 out of 10 will need an reintervention.

Hemiarthroplasty as a salvage treatment for failed reverse total shoulder arthroplasty (9902)

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Background: The implantation rates of reverse total shoulder arthroplasties (RTSAs) are increasing worldwide, as are the associated complications and revisions. This requires the discussion of salvage therapies for nonreversible arthroplasties. Revision to hemiarthroplasty may offer a valid fallback option in certain cases. The aim of this study was to analyze the incidence, indications and clinical outcomes, especially the reduction in pain levels.

Methods: A total of 1237 RTSA implantations between January 2005 and December 2018 with a minimum follow-up of 2 years were queried for revision to hemiarthroplasty before December 2019. The main indications and clinical outcomes (Constant-Murley score (CMS), Subjective Shoulder Value (SSV), range of motion, pain) were analyzed with a minimum follow-up of 1 year following revision to hemiarthroplasty.

Results: A total of 21 out of 1237 RTSAs (1.7%) underwent salvage revision to hemiarthroplasty at a mean time of 20±21 months (range, 1-75 months). The mean follow-up durations were 37±29 months (range, 12-123 months) following revision to hemiarthroplasty and 56±33 months (range, 24-124 months) after primary RTSA. The main indications for revision were complications related to the glenoid component (13/21), scapula spine fracture (3/21), instability (2/21), and infection (2/21). There was significant improvement in pain from 7±3 to 11±4 CMS points (15 best, p=0.3) but not in CMS (absolute 31±11 vs. 29±16 points, relative 38±15% vs. 38±20%) or SSV (31±20% vs 30±18%). The mean postoperative forward flexion and abduction were 50±25° and 45±22°, respectively.

Conclusion: Failed RTSA not feasible to retain is a burdensome complication. Conversion to hemiarthroplasty is a fallback treatment option for reducing patient pain levels at least to a certain degree.

Shoulder kinematics after anatomical total shoulder arthroplasty. Can scapular rhythm be restored to normal pattern in comparison to a healthy reference group? (9906)

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Introduction: Anatomical total shoulder arthroplasty is a common surgical procedure for the treatment of glenohumeral arthritis. Nevertheless little is known about the kinematics following this surgical procedure. Arm elevation in scapular plane is a coordinated motion in glenohumeral and scapulothoracic joints. We hypothesized that the normal (native) shoulder motion pattern can be restored after anatomical total shoulder arthroplasty.

Methods: We compared arm elevation in the scapular plane of 20 shoulders after anatomical total shoulder arthroplasty (TSA, 15 patients, minimum of 2 year follow up) and 40 shoulders of young adult volunteers (20 participants, no shoulder pathology). We used Vicom three-dimensional motion analysis system with high-speed infrared cameras and skin markers. Glenohumeral and scapulothoracic kinematics were studied using the Upper Limb Evaluation in Movement Analysis (ULEMA) model. Data analysis was performed with Metlab and R.

Results: Mean age of the surgical group was 66 years (10 females, 5 males) whereas mean age of the healthy volunteers was 27 years (7 females, 13 males). All patients with TSA had a normal shoulder range of motion and were very satisfied or satisfied with the result. After surgery we could show an altered motion pattern especially in the first 50 degrees of elevation. In the first 20 degrees of elevation, the scapula performed medial rotation (countermotion to executed arm elevation). This is compensated with increased motion in the glenohumeral joint. Above 70 degrees of elevation the motion pattern is comparable between the two groups.

Conclusion: The shoulder kinematics during lateral arm elevation is not restored to normal pattern at 2 year follow up after anatomical total shoulder arthroplasty. In comparison to the kinematics of healthy adults, the most important difference is visible during the first 20 degrees of elevation. Therefore postoperative physical therapy should focus on stabilization exercises of the scapula and strategies to initiate movement of the arm.

Sling vs Brace after Surgery for Supraspinatus Tears: A Randomized Controlled Trial. (9914)

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Introduction: After a surgical treatment of the supraspinatus tendon lesions, the rehabilitation protocol can include the use of braces that keep the limb in an established position (commonly at 15° or 30° of abduction) or a support mitella, less voluminous and with a lower limitation in terms of movements of the articulation.

Methods: 110 patients treated surgically for a lesion of the rotator cuff are enrolled and randomly assigned to use an ultrasling brace positioned at 15° in abduction for 6 weeks or to use a mitella for 2 weeks. Patients are re-evaluated at 6 weeks, 3 months, and 6 months with clinical questionnaires, a physical examination and, only at the 6-month visit, with a magnetic resonance imaging.

Results: Fifty-nine patients (30 brace, 29 mitella) have completed 6-month follow-up. There were no statistically significant differences in terms of improvement in the DASH score, Constant score, and VAS 0-10 for pain at any of the 3 follow-ups (6 weeks, 3 months, 6 months). At the 6th month of follow-up, clinical positivity was found in at least one of the diagnostic tests for rotator cuff lesions, in 7 out of 30 patients in the group assigned to the brace and in 6 out of 29 patients in the group assigned to the mitella, with no significant difference between the groups.

Conclusions: The use of mitella and the use of 15° abduction brace show both satisfactory clinical recovery, with no difference in clinical results after the surgery for the lesion of the supraspinatus tendon.

Similar scapular morphology in patients with dynamic and static posterior shoulder instability (9928)

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Background: There is evidence that specific variants of scapular morphology are associated with dynamic and static posterior shoulder instability. To this date, observations regarding glenoid and/or acromial variants were analyzed independently, with two-dimensional imaging or without comparison with a healthy control group. Therefore, the purpose of this study was to analyze and describe the three-dimensional (3D) shape of the scapula in healthy and in shoulders with static or dynamic posterior instability using 3D surface models and 3D measurement methods.

Methods: In this study, 30 patients with unidirectional posterior instability and 20 patients with static posterior humeral head subluxation (static posterior instability, Walch B1) were analyzed. Both cohorts were compared with a control group of 40 patients with stable, centered shoulders and without any clinical symptoms. 3D surface models were obtained through segmentation of computed tomography images and 3D measurements were performed for glenoid (version and inclination) and acromion (tilt, coverage, height).

Results: Overall, the scapulae of patients with dynamic and static instability differed only marginally among themselves. Compared with the control group, the glenoid was 2.5° (P = .032), respectively, 5.7° (P = .001) more retroverted and 2.9° (P = .025), respectively, 3.7° (P = .014) more downward tilted in dynamic, respectively, static instability. The acromial roof of dynamic instability was significantly higher and on average 6.2° (P = .007) less posterior covering with an increased posterior acromial height of +4.8mm (P = .001). The acromial roof of static instability was on average 4.8° (P = .041) more externally rotated (axial tilt), 7.3° (P = .004) flatter (sagittal tilt), 8.3° (P = .001) less posterior covered with an increased posterior acromial height of +5.8 mm (0.001).

Conclusion: The scapula of shoulders with dynamic and static posterior instability is characterized by an increased glenoid retroversion and an acromion that is shorter posterolaterally, higher, and more horizontal in the sagittal plane. All these deviations from the normal scapula values were more pronounced in static posterior instability.

Impact of 30 years high-level rock climbing on the shoulder – an MRI study of 31 climbers (9929)

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Background: Rock climbers are particularly susceptible to shoulder injuries due to repetitive upper-limb movements on vertical or overhanging terrain. However, the long-term effects of prolonged climbing on the shoulder joints are still unknown.

Purpose: The purpose of this study was to analyze the prevalence of pain and degenerative changes in the shoulder joints after high-level rock climbing over at least 25 years. We hypothesized that specific climber-associated patterns of degeneration would be found.

Methods: Thirty-one adult male high-level rock climbers were compared to an age- and sex-matched control group of 31 nonclimbers. All participants underwent a detailed interview, standardized clinical examination, and bilateral (climbers) or unilateral (nonclimbers, dominant side) magnetic resonance imaging (MRI) scans. Clinical and MRI findings of the groups were compared.

Results: The lifetime prevalence of shoulder pain in the rock climbers was 77%. The rock climbers had significantly more abnormalities in the labrum (82% vs. 52%; p = 0.002), long biceps tendon (53% vs. 23%; p = 0.006), and cartilage (28% vs. 3%; p = 0.005). These increased changes positively correlated with climbing intensity. There were no differences between the two groups with respect to rotator cuff tendon pathology (68% vs. 58%; p = 0.331) and acromioclavicular (AC) joint degeneration (88% vs. 90%; p = 0.713). Despite the increased degeneration

tive changes in the rock climbers, their Constant score (CS) was still better than that of the nonclimbers (CS 94, IQR [92,97] vs. CS 93, IQR [91,95]; $p = 0.019$).

Conclusions: Prolonged high-level rock climbing leads to a high prevalence of shoulder pain and increased degenerative changes to the labrum, long biceps tendon, and cartilage. However, it is not related to any restriction in shoulder function.

Posterior stability of the shoulder depends on acromial anatomy! A biomechanical proof of concept study (9950)

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BACKGROUND: Static posterior glenohumeral subluxation leads to eccentric osteoarthritis (OA). Current surgical treatment correcting glenoid retroversion neither durably corrects posterior subluxation nor prevents progression of OA into Walch type B glenoids. As type B scapulae are characterized by a higher and horizontally oriented acromion we set out to test the hypothesis that the normal acromion is as a restraint for posterior humeral head translation and that restoration of normal anatomy of the acromion in a typical B1 scapula counteracts posterior translation and dislocation.

METHODS: Six 3-D printed scapular models were tested in a biomechanical shoulder simulator: (1) a statistical shape model (SSM) of the "normal" scapula, (2) an average scapula with a B1 glenoid, (3) scapula with a B1 glenoid after correction of glenoid orientation, (4) scapula with a B1 glenoid after correction of acromion orientation, (5) scapula with a B1 glenoid after correction of glenoid and acromion orientation, (6) a model of a shoulder with dynamic posterior shoulder instability with normal glenoid version of 0° but a highly pathological acromion. Tests provoking posterior subluxation were conducted in 35°, 60° and 75° of glenohumeral flexion: With the joint axially loaded (100N) and the humerus stabilized, a controlled anterior translation force was applied to the scapula. The test was stopped when either a force of 40N (acromion contact) was reached or at posterior dislocation. Translation (mm) between start and end point was measured. Pressure sensors documented acromion contact and the path of the humeral head on glenoid and acromion.

RESULTS: In 35° flexion, none of the shoulders except for the dynamic model dislocated. The "B1", "B1 Acromion Correction" and "dynamic" model, however showed substantially increased posterior translation upon standardized loading ($p < .001$). In 60° flexion, only the "SSM" and "B1 Acromion + Glenoid Correction" did not dislocate. In 75° flexion all models dislocated.

CONCLUSIONS: Upon controlled, experimental posterior glenohumeral subluxation, normal acromial anatomy substantially decreases posterior translation and compulsory acromio-humeral contact prevents posterior dislocation. In 60° of glenohumeral flexion (90° of global flexion) stability can only be achieved if glenoid and acromial anatomy are restored to normal. Correction of excessive glenoid retroversion alone does not prevent abnormal posterior translation or dislocation.

Factors Influencing Functional Internal Rotation after Reverse Total Shoulder Arthroplasty (9951)

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BACKGROUND: Functional internal rotation (fIR) of the shoulder is frequently limited after reverse shoulder arthroplasty (RTSA). The objective of this study was to study a cohort of satisfied patients after RTSA who had comparable active mobility except for fIR and to identify factors associated with selective loss of fIR.

METHODS: A retrospective cohort study was conducted to compare two patient groups with either poor (≤ 2 points in the Constant-Murley score (CS)) or excellent (≥ 8 points in CS) fIR after RTSA at a minimum

follow-up of 2 years. Influencing factors (demographic, surgical or implant related, radiographic parameters) and clinical outcome were analyzed.

RESULTS: 52 patients with a mean age of 72.8 (± 9.3) and a mean follow-up of 41 months were included in the IR ≤ 2 group and 63 patients with a mean age of 72.1 (± 8.0) and a mean follow-up of 59 months in the IR ≥ 8 group. All patients had undergone RTSA with the same implant type and only two different glenosphere sizes (36 and 40) for comparable indications. A multivariate analysis identified the following significant risk factors for poor postoperative fIR: poor preoperative fIR (pts in CS: 3 (range: 2-6) vs. 6 (range: 4-8), $p < .0001$), smoking (17.3% vs. 6.5%, $p = .004$), male gender (59.6% vs. 31.7%, $p = .002$), less pre- to postoperative distalization of the greater tuberosity (± 19.4 mm vs. 22.2 mm, $p = .026$), a thin humeral insert (≤ 3 mm: 23.1% vs. 54.8%, $p = .039$) and a high ASA score (\leq III: 30.8% vs. 14.3%, $p = .043$). Subscapularis repair status and glenosphere size had no influence on fIR. Clinical outcome scores improved in both groups from preoperatively to last follow-up. The IR ≥ 8 group had overall significantly better outcome scores compared to the IR ≤ 2 group ($\pm 9.3\%$ SSV and $\pm 9.5\%$ relative CS, $p < .0001$). There was no difference in CS between the cohorts when the score for fIR was discarded.

CONCLUSION: Independent risk factors for poor postoperative fIR after RTSA are poor preoperative fIR, smoking, male gender, less pre- to postoperative distalization of the greater tuberosity, a thin humeral insert height and a high ASA score. Except for male gender, these factors are modifiable. These findings may be a valuable addition to patient counselling as well as preoperative planning and pre- and intraoperative decision-making. The relevance of fIR for overall satisfaction is substantiated by this study.

Extension of the Shoulder is Essential for Functional Internal Rotation After Reverse Total Shoulder Arthroplasty (9953)

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BACKGROUND: The importance of functional internal rotation (fIR) of the shoulder is increasingly recognized. Unsatisfactory fIR after reverse total shoulder arthroplasty (RTSA) is frequent but unexplained. This study tested the hypothesis that limitation of fIR after RTSA is primarily related to a deficit of active extension rather than internal rotation of the shoulder.

METHODS: Fifty consecutive patients (mean age at RTSA: 70 (range, 40-100) years) were prospectively examined with special attention to fIR at a median of 4 years (range: 1-10 years). Patients with axillary nerve or deltoid dysfunctions were excluded. Extension was measured as the angle formed by the fully, actively extended shoulder and the trunk. Relative Constant-Murley Scores (rCS), Subjective Shoulder Values (SSV) and four activities of daily living (ADLs) requiring fIR were assessed. For analysis, patients were divided into a group with poor fIR ("fIR-") defined as ≤ 2 IR CS points, and a group with good fIR ("fIR+") with at least 4 IR CS points.

RESULTS: Active extension of the contralateral shoulders were comparable in the fIR- (mean (SD): 60.3° (± 11.2)) and the fIR+ (66.1° (± 14.2)) groups. With a mean of 55° (± 14.3), active shoulder extension was an average of 16° greater in the fIR+ than in the fIR- group (39.1° (± 10.8); $p < 0.001$). In the fIR+ group no patient had an active extension $< 40^\circ$ (range 40-85°). Shoulders with extension $\geq 40^\circ$ but unsatisfactory fIR, usually had severe subscapularis fatty infiltration. The ability to perform ADLs behind the back correlated better with humeral extension than with the internal rotation CS.

CONCLUSION: For fIR after RTSA a humeral extension of 40° is mandatory. Only if 40° of extension are obtained, can severe subscapularis dysfunction prevent satisfactory fIR. Although essentially never reported, shoulder extension is as a crucial active movement to be preserved or restored during RTSA to allow performing ADLs.

Fixation of distal clavicle fractures with coracoclavicular instability – A comparative biomechanical study in human cadavers (9961)

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Introduction: The biomechanical need for CC stabilisation in the fixation of fractures with coracoclavicular (CC) instability (Neer type IIB and V) has been demonstrated by construct strength superior to that of isolated locking plate osteosynthesis. It was the purpose of this study to proof non-inferiority of the new cow-hitch suture repair technique compared to the well-established suture tape double-button fixation with regard to overall fixation strength and cyclic loading properties.

Methods: Twelve human cadaver shoulders (7 right, 5 left) were matched for sex and age (mean age 75 ± 5 years). An oblique parasagittal fracture line 20 mm medial to the AC joint line was created and the CC ligaments were dissected. Six shoulders were reconstructed by a double FiberTape® fixation with two suture buttons (group DB), the remaining six shoulders by a novel cow-hitch suture repair using a double FiberWire® with only coracoid button fixation (group CH). Both reconstruction techniques were tested in a servo-hydraulic material testing machine for cyclic displacement (mm), stiffness (N/mm) and maximum load-to-failure (N) after 500 cycles at 3 mm/s and inferosuperior load between 15 and 70 N. Superior fragment displacement in space was recorded using a MicroScribe digitizer.

Results: There were no statistically significant differences regarding cyclic displacement (group DB: 0.7 mm; group CH: 1.3 mm; p = 0.36), stiffness (group DB: 177 N/mm; group CH: 116 N/mm; p = 0.17), maximum load-to-failure (group DB: 560 N; group CH: 492 N; p = 0.59) and superior displacement in space of the medial fragment (group DB: 3.2 mm; group CH: 1.6 mm; p = 0.48).

Conclusion: Fixation of unstable distal clavicle fractures using a novel double FiberWire® cow-hitch suture repair with isolated coracoid button fixation for stand-alone CC stabilization resulted in similar construct properties as a double suture button fixation with FiberTapes® whilst avoiding prominent clavicular implants.

Vergleich zwischen lateralisierter und nicht lateralisierter inverser Schultertotalendoprothese bei fortgeschrittener Defektarthropathie Hamada 4 und 5 mit glenohumeraler Arthrose (9980)

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Introduction: Fortgeschrittene Defektarthropathien medialisieren das Gelenkzentrum. Ein lateralisiertes Design in der inversen Schulterendoprothetik (invTP) soll funktionelle Ergebnisse, vor allem die Rotationsbewegung, verbessern.

Methods: Patienten mit Hamada 4 und 5 Defektarthropathie erhielten zwischen März 2015 und Juni 2018 eine invTP und wurden prospektiv 2 Jahre dokumentiert. Patienten mit Teres Minor Insuffizienz wurden ausgeschlossen. Die Gruppen waren: "lateralisiert" (LAT) mit 135° Humerusneigung und 36 + 4 mm lateralisierter Glenosphäre (n = 19) und "nicht lateralisiert" (NONLAT) mit 155° Humerusneigung und 36 + 2 mm exzentrischer Glenosphäre (n = 12). Der Bewegungsumfang, der Constant-Murley-Score (CS) und Shoulder Pain and Disability Index (SPADI) wurden erhoben. Messungen der Skapula- und Glenoidanatomie, der Baseplate- und Glenosphärenposition sowie Lateralisierungs- und Distalisierungsparameter wurden konventionell radiologisch durchgeführt. Lineare Regression und gemischte Modelle wurden an Geschlecht und präoperative Werte angepasst.

Results: Die Basisparameter waren vergleichbar. Die CS- (Unterschied 0,7 Punkte (95%CI -9 bis 10,4); p = 0,947) und SPADI-Ergebnisse (-7 Punkte (-22,1 bis 8,2); p = 0,850) unterschieden sich nicht. Die Außenrotation der Gruppe LAT (Mittelwert 33°) war höher als die der Gruppe NONLAT (19°) (-15° (-26,8 bis -3,1); p = 0,015); Mehr Patienten der Gruppe LAT konnten den Lendenwirbel 3 erreichen (79% gegenüber 25% in der Gruppe NONLAT) (p = 0,043). Die Gruppe NONLAT hatte

mehr unteren Überhang der Glenosphäre (2,4mm (0,9 bis 4,0); p = 0,004), Medialisierung des Rotationszentrums (COR) (4,5mm (1,2 bis 7,8); p = 0,024), Tieferverschiebung des glenohumeralen Rotationszentrums (5,4mm (1,4 bis 9,3); p = 0,013), grösseren Distalisierungswinkel (13,4° (5,9 bis 20,8); p = 0,002) sowie eine tiefere Baseplateposition (-0,1 (-0,1 bis -0,0); p = 0,010) während die Gruppe LAT mehr laterales Humerusoffset (-12,7mm (-16,3 bis -9,0); p < 0,001) und einen höheren Lateralisierungswinkel (-17,4° (-24,3 bis -10,4); p < 0,001) aufwies. Scapular Notching zeigte keinen signifikanten Unterschied (p = 0,421).

Conclusion: Unsere Daten bestätigen die Hypothese, dass eine inverse Schulterendoprothese mit Humerusneigung von 135° und lateralisierter Glenosphäre eine bessere Rotation im Vergleich zu einer Prothese mit 155° und exzentrischer Glenosphäre bei fortgeschrittener Defektarthropathie Hamada 4/5 ermöglicht. Die Outcome-Scores zeigten in unserem Kollektiv ähnliche Ergebnisse

Reverse Total Shoulder Arthroplasty in Patients with Type B2, B3, and Type C Glenoids: comparable clinical outcome to patients without compromised glenoid bone stock: A Matched Pair Analysis (10000)

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Background: Primarily posterior bone deficient (dysplastic) (Walch Type C) or secondarily eroded (Walch Type B2 or B3) glenoids represent a surgical challenge for shoulder arthroplasty. Due to the posteriorly static decentered head, reverse total shoulder arthroplasty (RTSA) is often considered as treatment of choice. The purpose of this study is to report the clinical and radiographic outcomes, complications and reoperations of RTSA for posteriorly deficient glenoids.

Materials and methods: All patients who underwent RTSA for osteoarthritis secondary to underlying glenoid deficiency (Walch type B2, B3 and C) between 2005 to 2018, were identified from our institutional shoulder arthroplasty data base and gender- and age- matched to a cohort of patients with normal glenoid bone stock. Longitudinal pre- and postoperative clinical (Constant-Murley (CS) score, Subjective Shoulder Value (SSV)) and radiographic outcomes were assessed.

Results: We included 188 patients (94 in each group). The median follow-up was 43 ± 26 (24 to 144) months in the study group and 59 ± 32 (24 to 124) months in the control group. The surgical site complication and revision rate of RTSA in patients with bony deficient glenoids were 17% and 7%. If revision could be avoided the RTSA resulted in considerable improvement of pain (CS pain score from 6 to 14 points), function (absolute CS from 36 to 67 points), force (1.7 to 3.4kg) and patient satisfaction (SSV from 36 to 80%). Although glenoid loosening was slightly higher in the study group (5 vs. 2), overall no significant differences were found between the study and control groups in satisfaction scores, preoperative and postoperative absolute and relative Constant scores, complication and revision rates, respectively.

Conclusion: RTSA seems to be a valuable treatment option for patients with primary (dysplasia) or secondary (wear) posterior glenoid deficiency. Although severe glenoid bone loss seems to be a risk factor for glenoid component failure, the overall complication and revision rates as well as clinical and radiographic outcome are comparable to RTSA in patients without compromised glenoid bone stock.

Level of evidence: Level III: Case-control study

Keywords: Glenoid Dysplasia; Retroversion; Reverse Total Shoulder Arthroplasty, Osteoarthritis of the Shoulder, Shoulder Arthroplasty

Influence of malrotated anteroposterior radiographs on humeral measurements in proximal humeral fractures (10002)

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Introduction: Displacement of proximal humeral fractures (PHF) as assessed by neck-shaft angle (NSA) and offset measurements predicts

clinical outcome. Malrotation of radiographs may influence these measurements and affect clinical decision-making. Therefore, it was the aim of this study to analyze the effect of malrotated radiographs on proximal humeral measurements in PHF.

Methods: Ten consecutive patients with displaced PHF, available bilateral CT scan, and a precise initial true anteriorposterior (AP) radiograph were included. Digitally reconstructed radiographs (DRRs) of the injured and uninjured side were aligned to obtain a true AP view. Different viewing angles with 10° increments ($\pm 30^\circ$ maximum) were generated by rotation around the horizontal (flexion/extension) and vertical axis (ante-/retroversion) of the scapula. NSA and eccentric head index (EHI) were measured by two independent readers to assess intraclass correlation coefficients (ICC) and 95% limits of agreement (LoA). The influence of malrotation was assessed by paired comparisons, as were the differences in NSA and EHI between clinical and digital true AP views.

Results: True AP DRRs approximated the clinical true AP view by a mean difference of 3° and a LoA range of 12° for NSA, and a mean difference of 0.12 and a LoA range of 0.36 for EHI ($p < .02$). NSA in injured shoulders was most susceptible to malrotation around the vertical axis ($p < .03$), with largest differences seen for anteversion, whereas $\pm 10^\circ$ of vertical malrotation did not influence NSA in uninjured shoulders. While DRRs malpositioned in extension had no influence on NSA ($p > .70$), $\geq 20^\circ$ and 30° of flexion demonstrated differences in injured and uninjured shoulders, respectively ($p < .05$). EHI was only influenced by malrotation in anteversion in uninjured shoulders ($p < .03$). ICCs were good (> 0.7) for all viewing angles in the injured shoulders, but varied widely in the uninjured shoulders.

Conclusion: This study highlights distinct differences in susceptibility for malrotated radiographs between fractured and uninjured shoulders. NSA is more susceptible to malrotated radiographs than EHI, with malrotation in anteversion demonstrating the most substantial differences. Since images with malrotation in anteversion are particularly frequent in patients with PHF on first admission, clinicians should be aware of the false interpretation of NSA in these cases.

Outcome of management of fractures of the proximal humerus using a patient-specific, evidence-based treatment algorithm (10110)

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Background: Previous prospective studies have identified person – specific risk factors for different types of treatment of proximal humeral fractures (PHF) and allowed the creation of a treatment algorithm with the potential to improve overall outcome and to reduce the complication rate. It was the purpose of this study to evaluate the results and complications of treatment of PHF using a patient specific, evidence-based algorithmic approach

Materials and Methods: All patients with isolated PHF between 2014 and 2017 were included and prospectively followed. The initial treatment algorithm (V1) based on patient's functional needs, bone quality and fracture type, was further refined after 2 years (V2). Adherence to protocol, clinical outcome and complications were analyzed at 1 year post trauma.

Results: The study included 334 patients (mean age 66 years, 68% female): 226 were treated conservatively, 60 with open reduction internal fixation (ORIF), 39 with RTSA and 4 with hemiarthroplasty. After 1 year, the pre-injury EQ-5D values were regained (0.88 vs 0.89) and the respective mean relative Constant Score (rCS) and mean subjective shoulder values (SSV) were 96% and 85%. Overall complication and revision rates were 19% and 13%. Treatment conforming to the algorithm outperformed non-conforming treatment with respect to rCS (97% vs 88%, $p = 0.016$), complication rates (16.3% vs 30.8%, $p = 0.014$) and revision rates (10.6% vs 26.9%, $p < 0.001$).

Conclusion: Treatment of PHF using a patient specific, evidence-based algorithm restored pre-injury quality of life as measured with EQ-5D and approximately 90% of a normal shoulder as measured by CS and SSV. Adherence to the treatment algorithm was associated with significantly better clinical outcome and a substantially reduced complication and revision rate.

A02 – HAND

How to improve the performance of outpatient surgery in hospitals designed for inpatient surgery? The example of hand surgery under WALANT (9765)

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Introduction: Most Swiss hospitals were built in the 70s and 80s, a time when inpatient surgery was the standard. Within the last decade, outpatient surgery has widely developed in order to reduce health care costs. In addition, the COVID-19 pandemic has significantly reduced accessibility to operating rooms due to the shortage of anesthesiologists recruited to intensive care units. In response, we have reorganized our practice by carrying out full days of surgery dedicated to patients who undergo surgery under “Wide Awake Local Anaesthesia, No Tourniquet” (WALANT).

The aim of this study is to assess the impact of the WALANT technique on both, surgery and turnover times, in patients who have surgery for carpal tunnel syndrome or spring finger in mini-open technique.

Method: This is a retrospective study comparing patients who had carpal tunnel release or spring finger release either under endovenous anaesthesia (EVA) performed by an anaesthesiologist or under WALANT performed by the surgical team. Surgery involving other simultaneous procedures were excluded. Surgery time was measured from incision to closure and turnover time was measured from closure of the previous procedure to incision of the next. The time preceding the first surgery of the day was not counted. Surgery time of senior and junior surgeons were compared.

Results: Between January 2017 and January 2021, 80 carpal tunnel releases (50 under EVA and 30 under WALANT) and 72 spring finger releases (42 under EVA and 30 under WALANT) were carried out. The mean surgery time of carpal tunnel release by senior surgeons was 12.3 minutes under EVA and 15.3 minutes under WALANT (p-value 0.85) and the mean surgery time by junior surgeons was 14.6 minutes under EVA and 20.1 minutes under WALANT (p-value <0.05). The mean surgery time of spring finger release by senior surgeons was 10.4 minutes under EVA and 10.0 minutes under WALANT (p-value 0.532) and the mean surgery time by junior surgeons was 16.0 minutes under EVA and 15.8 minutes under WALANT (p-value 0.49). The turnover time for EVA and WALANT was 37.2 minutes and 18.3 minutes, respectively (p-value <0.00001).

Conclusion: Despite the COVID-19 pandemic, the switch to days dedicated to patients having surgery under WALANT improved the performance of the outpatient operating rooms. A slight increase in surgery time in carpal tunnel surgery under WALANT was compensated by halving the turnover time between two surgeries.

3D planning and patient specific instrumentation for intraarticular corrective osteotomy of trapeziometacarpal and finger joints (9864)

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Introduction: Intraarticular corrective osteotomies with the aim of restoring joint congruency are indicated when posttraumatic bone deformities become symptomatic. The aim of the study was to evaluate joint congruency, feasibility and functional outcome of 3D printed patient-specific instrumentation (PSI) for corrective osteotomies of malunions of intraarticular fractures in trapeziometacarpal and finger joints with a minimally invasive approach to the affected joint.

Methods: Patients who underwent an intraarticular corrective osteotomy at the metacarpals (MC) or phalanges were included. Preoperative CT scans were acquired of the malunited and the contralateral bone. Segmentation was followed by analysis of malposition and surgical planning with a software allowing standard computer-aided design (CAD) functions. Automatic volumetric fitting, quantification of malposition, calculation of cutting planes and the design of individualized bone surface contact drilling, sawing and reposition guides were performed. The surgical procedure was realized using PSI and arthrotomies were documented. Postoperative clinical follow up included range of motion (ROM) and grip strength. Joint congruency and consolidation was analyzed with CT scans.

Results: Ten patients (mean age 28.4 ± 12.8 years, range 14 – 51 years) were included with a mean follow up of 21 ± 18 months (3 – 59 months). Eight osteotomies were localized at the MC and two at the proximal phalanx. Corrections at the trapeziometacarpal joint were performed using a mini-arthrotomy. No arthrotomy was performed at the phalanges. Mean combined ROM increased from 112° ± 69° to 128° ± 82° (p=0.001). Average grip strength (47.8 ± 8.1kg) did not differ to the contralateral side (47.8 ± 8.1kg, p=0.818). All articulations showed joint congruency and osseous consolidation 61 ± 8 days (54 – 78 days) postoperative.

Conclusion: PSI reliably corrects intraarticular deformities at the trapeziometacarpal and finger joints without the need for an additional arthrotomy in the finger joints and improves functional outcome at medium-term follow up.

Low Profile Transverse Plating for Treatment of Dorsal Rim Fracture of the Distal Radius: A Mid-Term Follow-Up of Functional and Radiological Result. (9898)

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Introduction: The distal radius fracture accounts for 17.5% of all fractures in an orthopedic trauma unit. In case of intra-articular fractures with dorsal involvement, reduction by dorsal approach and plate fixation is preferred. The techniques described in the literature use two dorsal plates with a minimum thickness of 1.6 mm. At our institution, we have developed a new technique based on the three-column principle with an additional low-profile dorsal plate in place of the two dorsal plates. In this technique, we first stabilize the intra-articular fragments with a dorsal plate and then finish the construction with two dorsal plates. The edge plate was 0.6 mm thick and the dorsal plates were 1.0 mm thick. The purpose of this construction is to have a more accurate reduction of the joint surface and less conflict between the extensor tendons and the plate without sacrificing stability. This study evaluates the functional and radiological outcome of this technique.

Methods: Between 2012 and 2019, 16 patients underwent to osteosynthesis of distal radius with the novel techniques. All fractures were C3.2 (AO Classification). We evaluate the radiological result according BATRA anatomical score. The functional outcome was evaluating with the PWRE score.

Results: At a minimum follow up of 2 years the score the average of the PWRE score is 14.8/100. The average of Batra anatomical score is 90.4/100 (excellent). No cases showed extensor tendinitis as a complication.

Conclusion: Our technique involves the use of plates with a lower profile but with a structure, that reinforces the three columns in a more accurate manner. This allows a good reduction with a fixation as stable as techniques already described previously in the literature.

A03 – SPINE

Assessing fatty infiltration of paraspinal muscles in patients with lumbar spinal stenosis: Goutallier classification and quantitative MRI measurements (9680)

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Introduction: Fatty infiltration of paraspinal muscle is associated with spinal disorders. Fatty infiltration of muscle can be assessed qualitatively (i.e. Goutallier classification) and quantitatively using image processing software. The aims of this study were to compare paraspinal muscle fatty infiltration assessed using the Goutallier classification versus quantitative MRI measurements and to investigate the association between anthropometric parameters and paraspinal muscle morphology and fatty infiltration in patients with symptomatic lumbar spinal stenosis (LSS).

Methods: Patients affected by symptomatic LSS scheduled for surgery with available magnetic resonance images of the lumbar spine were included in this retrospective cross-sectional study. Fatty infiltration at each lumbar level was rated according to the Goutallier classification and quantified based on the cross-sectional area (CSA) of paraspinal muscle, of its lean fraction (LeanCSA), the ratio between LeanCSA and CSA and the CSA relative to the CSA of vertebral body (RCSA). Considering the muscle as a single unit, overall fatty infiltration according to Goutallier, overall CSA, LeanCSA, LeanCSA/CSA and RCSA were computed as averages (aGoutallier, aCSA, aLeanCSA, aLeanCSA/aCSA and aRCSA). Associations among parameters were assessed using Spearman's respective Pearson's correlation coefficients.

Results: Eighteen patients, mean age of 71.3 years, were included. aGoutallier correlated strongly with aLeanCSA and aLeanCSA/aCSA ($R=0.673$ and $R=-0.754$, both $P < 0.001$). There was a very strong correlation between values of the left and right sides for CSA ($R=0.956$, $P < 0.001$), LeanCSA ($R=0.900$, $P < 0.001$) and LeanCSA/CSA ($R=0.827$, $P < 0.001$) at all levels. Among all anthropometric measurements, paraspinal muscle CSA correlated the most with height (left: $R=0.737$, $P < 0.001$; right: $R=0.700$, $P < 0.001$), while there was a moderate correlation between vertebral body CSA and paraspinal muscle CSA (left: $R=0.448$, $P < 0.001$; right: $R=0.454$, $P < 0.001$). Paraspinal muscle CSA correlated moderately with BMI (left: $R=0.423$, $P < 0.001$; right: $R=0.436$, $P < 0.001$), and there was no significant correlation between aLeanCSA or aLeanCSA/CSA and BMI.

Conclusions: The Goutallier classification is a reliable yet efficient tool for assessing fatty infiltration of paraspinal muscles. We suggest to take body height as reference for normalization in future studies assessing paraspinal muscle atrophy and fatty infiltration.

O-arm and Surgivisio use for percutaneous vertebral cementoplasty: a comparative study on 121 patients (9705)

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Introduction: Vertebral compression fractures are frequent in the aging population, and are regularly treated by percutaneous vertebroplasty or kyphoplasty. Advances related to computerized navigation allow a more accurate surgery without new imaging acquisition, and related irradiation. New technologies trend to optimize the irradiation for the patient. The objective was to compare results of O-arm navigation and new all-in-one 2D/3D Surgivisio device in percutaneous cementoplasty procedures.

Methods: We retrospectively reported the results of all patients prospectively included for percutaneous navigated vertebroplasty or kyphoplasty for vertebral compression fractures during an 18-month duration in two spine centers. Demographic, operative and irradiation data were collected, as well as the image quality subjectively evaluated by the surgeon. Effective dose (E) in millisievert (mSv) was calculated using the PCXMC software and the recommendations of the International Commission for Radiological Protection.

Results: 121 patients were included, 60 in the O-arm group and 61 in the Surgivisio group. A total of 161 vertebrae were analyzed. Compared to the Surgivisio group, E was significantly higher in the O-arm group, with a mean of 11.58 versus 1.14 mSv respectively ($p < 0.001$). 2D part of E received by the surgeon was also significantly higher in the O-arm group, with an average of 2.18 versus 0.47 mSv respectively, $p < 0.001$. Operative time was also significantly higher in the O-arm group (34.17 versus 30.12 minutes respectively, $p = 0.044$). ANOVA method showed no correlation between E and surgeon level for both groups ($p = 0.240$ and $p = 0.171$ respectively). Image quality was similarly sufficient in 3D but significantly better in the O-arm group in 2D ($p = 0.013$).

Conclusion: With a 10 times higher radiation exposure with the use of the O-arm, technological advances in intraoperative imaging showed a clear dose reduction for patients and surgeons during percutaneous navigated cementoplasty, while keeping a sufficient image quality to perform the surgery.

Intraoperative duplex-ultrasound for safe surgical reduction of displaced hangman fractures in patients with atypical course of the vertebral artery: a case report of two patients. (9723)

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Introduction: An atypical course of the vertebral artery can be medically relevant in displaced Hangman fractures, especially if the artery course runs within the fracture gap of the C2 isthmus. During surgical reduction of the fracture, the artery can be entrapped and occluded inside the fracture, potentially leading to ischemic conditions of the brain. Duplex-ultrasound of the vertebral arteries is a safe, validated and non-invasive technique to measure the blood flow, to assess the morphology of the vertebral arteries and is commonly used as a neurovascular diagnostic method. The aim of this study was to report two cases according to the CARE (case reporting) guidelines, in which intraoperative duplex-ultrasound was performed to secure safe surgical management of hangman fractures in two patients with an atypical course of the vertebral artery.

Methods: Two patients with displaced Hangman fractures (Effendi-Levine type II) were diagnosed with an atypical course of the vertebral artery running through the fracture gap. This endangered safe surgical management with the risk of iatrogenic occlusion or injury during reduction through entrapment of the vessel inside the fracture gap. Therefore, an intraoperative duplex ultrasound of the vertebral artery in the segments V2 and V3, the segments proximal and distal of the fracture, was conducted before and after reduction, and at the end of the surgery by a neurovascular imaging specialist. The surgical treatment in both cases included closed reduction and posterior unilateral spondylosis of the cervical segment C2/3, followed by anterior cervical discectomy and fusion (ACDF) of the same segment.

Results: In both patients, a safe reduction of the fracture was performed. Neither occlusion nor dissection of the vertebral artery occurred. The duplex ultrasound before and after reduction, and at the end of the procedure showed normal flow of both vertebral arteries with excellent assessability. At follow-up examinations 6-weeks and 6-months postoperatively, the patients showed a favorable clinical outcome, radiographic signs of fusion, and no evidence of impairment of the vertebral artery.

Conclusion: This case report serves as proof-of-concept, demonstrating the feasibility of this regimen to minimize the risk of entrapment or occlusion of the vertebral artery in the surgical management of displaced Hangman fractures with atypical course of the vertebral artery running inside the fracture gap.

Pedicle Subtraction Osteotomy with vs without Patient Specific Guides (9860)

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Introduction: Patient-specific instruments (PSI) is well established for complex osteotomies in orthopaedic surgery and for placement of pedicle screws in spine surgery. However, PSI has not been employed for pedicle subtraction osteotomy (PSO) up to now.

Methods: 6 fresh frozen human cadavers were used to perform PSO's on the vertebrae L1, L3 and L5. Half of the PSO's (n=9) were performed with the traditional free-hand (FH, (n=9)) technique and the others with the use of 3D-printed guides (PSI). Preoperative CT-scans were obtained and 3D-segmented to develop the PSI. Each PSO-guide consisted of five parts, the ground block, which was attached to the upper and lower adjacent vertebrae with pedicle screw fixation, two posterior osteotomy blocks to cut the spinous process and laminae, and two anterior osteotomy blocks (left and right), which enabled a dorsally closing wedge osteotomy of the vertebral body while retracting the neural structures. The goal of each PSO was to gain a lordosis of 30° through the osteotomized vertebrae. Time was measured to execute the PSO's in both groups. Postoperatively, CT-scans were obtained to measure the accuracy of the planned versus executed PSO in the PSI group and to compare the FH-technique.

Results: The creation of additional lordosis was significantly more accurate with PSI compared to FH-technique with a mean difference to the aimed 30° in the PSI group being $2.35^\circ \pm 3.06^\circ$ versus $10.62^\circ \pm 4.24^\circ$ in the free-hand group ($p=0.004$). The gain of lordosis was significantly greater in the PSI than the FH group with $27.65^\circ \pm 3.06^\circ$ versus $22.01^\circ \pm 6.37^\circ$ ($p=0.027$). Furthermore, a significant reduction of the gap between the laminae adjacent to the posterior wedge could be achieved with the PSI technique $4.19 \text{ mm} \pm 2.65 \text{ mm}$ vs $11.81 \text{ mm} \pm 7.59 \text{ mm}$ with the FH-technique. The angular difference between the computer aided planning and execution of the osteotomy planes with the PSI technique was $3.8^\circ \pm 2.6^\circ$ and the metric distance between planned and executed osteotomy at the level of the lamina was $1.6 \pm 1.3 \text{ mm}$ and at the vertebral body entry point $1.4 \pm 0.9 \text{ mm}$. The time required to perform a PSO was $17:34 \pm 6:00 \text{ min}$ in the PSI group versus $14:33 \text{ min} \pm 3:30 \text{ min}$ in the FH group ($p=0.336$).

Conclusion: PSO with PSI was more accurate and achieved a greater gain of lordosis compared to the traditional FH procedure in the cadaver model. Investigation of this technique in human is warranted.

Robot-mounted digital 3D microscope for spinal decompression surgery (9892)

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Introduction: Surgical microscopes are established instruments for spinal decompression surgery. Potential new generations are developed, but not yet investigated systematically. The aim of this study was to evaluate the RoboticScope (BHS Technologies GmbH, Innsbruck, Austria), consisting of a head-mounted display, a microscopic camera and a robotic arm. The surgeons head movements are directly translated to the robotic arm which carries out the corresponding movement of the camera.

Methods: Two experienced spine surgeons each performed 3 laminotomies on a fresh-frozen cadaver using the RoboticScope (cadaveric study). The performance of the new device was evaluated with a likert-

scale questionnaire. The categories analyzed were visualization, usability, ergonomics, and overall impression. To directly compare the RoboticScope with a conventional microscope, an in vitro study was carried out. The experimental setup consisted of hollow 3D-printed boxes with an inner dimension similar to the spinal canal. Nine operators (3 experienced surgeons, 2 orthopedic assistants, 4 non-surgeons) were asked to identify and grip the lower of 2 spheres at top of 2 columns with different or same heights located inside the box. The number of failed gripping attempts, the height estimation and the time used were measured.

Results: In the cadaveric experimental setup, the RoboticScope was rated as equally good or superior to the conventional microscope in 14 of totally 24 questions (grade ≥ 3). In 10 questions, the experienced surgeons rated the new device as inferior (grade ≤ 2). In the in-vitro study, there were no significant differences between the microscopes concerning, both the errors in identifying the deeper sphere and the number of failed attempts at the grasp ($p=0.497$ and $p=0.451$). Similarly, there was no significant difference when comparing these factors between groups. In general, the average time in seconds to grasp the sphere using the RoboticScope was 6.06 ± 2.37 compared to 4.73 ± 2.13 using a conventional microscope ($p=0.01$). Neither surgical training nor multiple experimental runs appeared to have a significant effect ($p=0.575$ and $p=0.715$).

Conclusion: The RoboticScope seems applicable as a microscope in spinal decompression surgery. However, disadvantages still exist in usability and visualization. In terms of ergonomics, the RoboticScope proved to be advantageous over conventional microscopes.

Automated Pedicle Screw Trajectory Extraction from Postoperative CT Scans (9909)

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INTRODUCTION: Postoperative evaluation of spinal fusion surgery includes the examination of the pedicle screw trajectories on Computer Tomographies (CT). In addition to grading pedicle screw perforation using the Gertzbein-Robbin scale, a 3D analysis of the screw trajectories can provide more detailed information on deviations from the anatomical axes of the pedicles. However, 3D analysis requires segmentation of the bone anatomy and parameterization of the screws which are time-consuming tasks. A more automated method for 3D screw trajectory determination in postoperative CT would allow more efficient outcome assessment and quality control of treatments.

METHODS: In this study, a machine learning based algorithm is presented which is capable of calculating the 3D pedicle screw trajectory from postoperative lumbar spine CT in real-time. Given a CT scan, the algorithm extracts the start and end positions of all implanted screws without being affected by other metallic implants such as rods. The 3D trajectory of the pedicle screws is eventually calculated from these start and end points. Our method was evaluated on 14 postoperative CTs of lumbar spines against manually defined screw trajectories.

RESULTS: The average orientation error of the obtained screw trajectory was $1.66 \pm 0.93^\circ$ ranging from 0.13° to 3.97° . The total calculation time for one CT amounted to roughly 0.39 seconds on a high-end graphics card.

CONCLUSION: The accurate trajectory estimation along with the short computation time promote the use of our machine learning based algorithm for real-time extraction of screw trajectories from intraoperative CT scans. In the future, this may not only enable intraoperative screw trajectory evaluation, but would also thereby improve the surgical outcome and consequently increase treatment quality.

Spine fractures at a university hospital: proportional incidence, clinical characteristics and treatment – a retrospective 10-year analysis of a level one trauma centre (9977)

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Introduction: Fractures of the spine have a reported incidence of 19-90/100k. The occurrence of spinal fractures is often associated with a significant impact on activities of daily living and account for a significant socio-economic burden. Delayed diagnosis and missed injuries may lead to an increased morbidity and mortality. The aim of this study was to determine the (a) demographic characteristics, (b) proportional incidence, (c) treatment techniques with evolution over time, and (d) complications over a ten-year period

Material and Methods: Using our clinical information system, we obtained data from all patients suffering from an acute vertebral fracture between January 2003 and December 2012. The fractures were allocated for etiology (traumatic, osteoporotic and pathologic), management of the fracture, associated complications and site of occurrence

Results: (a) We identified 4,620 patients with 8 307 vertebral fractures equally distributed between males (n=2 300; 49.8%) and females (n=2 320, 50.2%)

The mean age at time of fracture was 61y (16-98y). Males suffering from vertebral fractures were younger and more frequently affected from traumatic injuries than females (predominantly osteoporotic fractures).

(b) The proportional incidence for trauma-associated fractures was 49% (4063 fractured vertebrae). Osteoporotic fractures accounted for 3366 fractures (41%), and pathologic fractures for 878 fractures (10%).

(c) More than two thirds of fractures needed surgical treatment (5 695 fractures = 68.6%). Especially the mid and lower thoracic spine as well as the lumbar spine were more often treated surgically. After 2009 there was a significant decrease in surgery for osteoporotic fractures. While in 2009 and before the adjusted probability for surgery in osteoporotic fractures was 88.6% (95% CI: 87.0%-90.2%) in 2010 and after the adjusted probability decreased to 79.0% (95% CI: 74.1% – 83.9%).

(d) Out of 4622 surgeries performed, we found 290 complications in 260 patients. Implant Failure was the most frequent complication (82/290= 28%) followed by surgical site infection (58/290= 20%).

Conclusion: From 2003-2012 fractures treated at the university hospital of Bern were equally distributed between men and women. Male patients suffering from vertebral fractures were younger and more prone to traumatic injuries, while women more often suffer from osteoporotic fractures. There is a strong decrease with surgical intervention in osteoporotic fractures after 2009

Development of a crosswalk for the bidirectional mapping of two commonly used condition-specific patient-reported outcome measures, the Oswestry Disability Index (ODI) and the Core Outcome Measures Index (COMI) (9982)

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Introduction: Cross-walking is a method of mapping scores on different patient-reported outcome instruments that measure similar domains. It requires that changes in outcomes from two measures in the same individuals should be correlated and similarly responsive to change. The Oswestry Disability Index (ODI) and the Core Outcome Measures Index (COMI) are two commonly used self-rating outcome instruments in patients with spinal disorders. However, there is currently no formal cross-walk between the two that would otherwise allow the scores of one to be interpreted in terms of the other. This study aimed to create such a cross-walk.

Methods: We performed a secondary analysis of data from conservative and operative patients with spinal disorders, from 2 observational studies and a registry (N = 3324 patients; 57±17y; 60.3% female), that had completed both an ODI and COMI at baseline and 1-year follow-up (FU). Correlations between the two instruments' baseline scores, FU scores and change-scores (baseline and 1y FU) were computed. The Cohen's kappa for agreement (κ) was calculated with respect to achievement of the minimal clinically important change (MCIC) score on each instrument (ODI, 12.8 (Copay et al 2008) points; COMI, 2.2 points (Mannion et al 2006)) using the actual change-scores for each as well as those predicted from the change-scores on the alternative instrument. It was hypothesized that baseline, FU, and change-scores for the two instruments would be at least moderately correlated ($r > 0.5$) and have moderately similar responsiveness ($\kappa > 0.4$ for agreement in % reaching MCIC).

Results: All pairs of measures were significantly positively correlated (baseline, 0.73; 1yr FU, 0.84; change-scores, 0.73). Overall, 53.9% patients achieved MCIC based on COMI change-scores and 52.4%, based on ODI change-scores; on an individual basis, there was 78% agreement between them, with $\kappa = 0.56$. The corresponding figures for achievement of MCIC based on individuals' change-scores predicted from their change-scores on the alternative instrument were 56.6% and 55.6%, respectively ($\kappa = 0.56$).

Conclusion: Many institutions exhibit a preference for the use of one outcome instrument over another, and have a history of data collection with their chosen instrument; the ability to share data via the developed crosswalk, to convert scores between the two scales, should open up more centres/registries for collaboration and facilitate the pooling of data in meta-analyses.

Transforaminal Thoracic Interbody Fusion: patient-reported outcome at 12 months (9998)

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Introduction: Transforaminal interbody fusion was initially popularized by Jeszenszky & Harms for the lumbar spine (TLIF). The same approach has later been introduced on the thoracic spine (TTIF) near the spinal cord. Only a few publications have reported the clinical results of TTIF, mostly case reports or small series, and rarely including patient-reported outcomes. Here we report the patient-reported outcome of TTIF at 1-year follow-up.

Methods: A search was performed in our institutional spine register, which is based on the Spine Tango registry framework. Included were all TTIF procedures performed at least one year prior to data extraction, from 2012 to 2020. Patients had been asked to complete the Core Outcome Measures Index (COMI) before surgery and 12 months later.

Results: In total, 62 patients had undergone TTIF within the study's time-frame (21 males, 41 females; mean age 64.8 (SD 18.7) years). Altogether, TTIF was performed on 78 levels by four different surgeons. The primary diagnosis was degenerative spine disease in 39 (63%) cases, fracture-related spine disease in 18 (29%) cases, and non-degenerative deformity in 5 (8%) cases. The majority of the TTIF procedures were performed on the lower thoracic spine, with the level of procedure being T3/4 in 2, T6/7 in 1, T7/8 in 1, T8/9 in 3, T9/10 in 5, T10/11 in 4, T11/12 in 27, and T12/L1 in 35 cases. A prefabricated cage was used in 55 (70.5%), Harms cage in 16 (20.5%), autograft in 6 (8%), and allograft in 1 (1%) of the TTIFs. Overall, 50/62 (81%) patients completed a preoperative COMI and 52/62 (84%) a 1-year COMI. A total of 42 (68%) patients completed both a preoperative and a 1-year FU COMI. Their COMI score reduced from a mean (SD) value of 8.0 (SD1.9) preoperatively to 5.0 (SD 2.4) at 12 months' follow-up. 63.5% of patients reported that the operation helped/helped a lot, and 71.2% were satisfied/very satisfied with their care. There were two intra-operative dural lesions, two wound infections, and one case of postoperative sensory dysfunction.

Conclusions: Transforaminal Interbody Fusion is a feasible approach to be used in the thoracic spine where interbody support and/or correction of a deformity is needed. There were no iatrogenic spinal cord lesions

reported nor any other major surgical complications. Patient-reported outcomes showed that there was clinically significant improvement at 12 months' follow-up, with a majority of the patients being satisfied with their care.

Development of a machine-learning based model for predicting multidimensional outcome after surgery for degenerative disorders of the spine (9999)

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Background: Recent years have seen the emergence and increasing use of patient-reported outcomes in clinical studies of treatment effectiveness, and it has become clear that individual outcomes can be quite heterogeneous. When consenting a patient for surgery, it is important to be able to offer an evidence-based, individualised prediction regarding the likely outcome. This study used a comprehensive set of data collected over 12 years in an in-house registry to develop a parsimonious model to predict the multidimensional outcome of patients undergoing surgery for degenerative spinal pathology.

Methods: Data from 8374 patients (mean age 63.9 (14.9-96.3) yrs, 53.4% female) were used for model development, predicting the 12-month scores for the Core Outcome Measures Index (COMI) and its subdomain scores. The data were split 80:20 into a training and test set. The top predictors were selected by applying recursive feature elimination based on a Lasso cross validation model retaining the top 15 predictors (out of 172) per outcome, allowing the retention of a practical number of 20 (out of 39) input variables to be used as a clinical decision-support system (CDSS). Based on the 111 top predictors (of the 20 variables), Ridge cross validation models were trained, validated, and tested for each outcome dimension.

Results: Preoperative back and leg pain, nationality, the number of previous spine surgeries, age, type of intervention, preoperative quality-of-life, body-mass index, number of affected levels, Charlson comorbidity, and ASA score, were among the strongest outcome predictors in most models. The R² of the models on the validation/test sets averaged 0.16/0.13. Models based on all 39 input variables performed only slightly better in terms of R² (0.17/0.14) underlining the good performance of the CDSS based on 20 input variables. A preliminary online tool was programmed to present the predicted outcomes for individual patients, based on their presenting characteristics.

Conclusion: The prediction models provide reliable estimates to enable a bespoke prediction of the outcome of surgery for individual patients

with varying degenerative pathologies and baseline features. The models form the basis of a simple, freely-available online prognostic tool developed to improve access to and usability of prognostic information in clinical practice. This should serve to facilitate decision-making and assist in managing patient expectations.

3D Printed highly porous trabecular titanium (3DTi) cervical interbody cages using electron beam melting technology promote early in vivo bony ingrowth. A preliminary report of a prospective analysis (10012)

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Introduction: Encouraging in vitro results suggest that highly porous trabecular titanium 3D-printed (3DTi) cages modeled using electron beam melting technology (EBM) and with a similar structure to the trabecular bone display the ability to stimulate osteogenic cell proliferation and differentiation. These implant intrinsic properties might offer an increased capacity for osteoinduction and potential for bone regeneration. The objective of this study was to investigate the osteointegration and bone ingrowth capabilities as well as the safety and efficiency profile of a 3DTi cervical cage in vivo.

Methods: We performed a prospective analysis of 20 consecutive patients presenting with degenerative cervical spine conditions and benefiting from one- up to three-level ACDF. Last-generation 3DTi cages made of highly porous trabecular titanium and 3D printed using the CAD/CAM technology by means of EBM (MT Ortho s.r.l., Aci Sant'Antonio, CT, Italy) were implanted. These innovative anatomically structured cages consist of two trabecular titanium endplates, with a porosity of 80% and a pore size of 1 mm, and lateral windows with a central cavity for cell colonization and subsequent bone regeneration. Anterior plate support was added depending on the pre-op findings and presence of myelopathy. Fusion rates were assessed using a CT-scan at 3 months and 1 year. The VAS pain score and NDI were also evaluated.

Results: Early bony ingrowth through the cage was observed in 100% of patients at 3-months. Fusion was achieved in 83.3% and 100% of cases at 3 months and 1 year respectively. VAS score for radicular pain and axial pain showed an improvement in 89.2% and 75.8% of cases. An improvement of the NDI by 74.5% was observed. No cage subsidence or migration was recorded. No major implant-related peri-operative complications were noted.

Conclusions & perspectives: In accordance with recent in vitro studies, 3DTi cervical cages showed frequent early bony ingrowth and excellent fusion rates with an optimal safety profile. These results appear to be independent from the diagnosis or additional plating. Our preliminary data on fusion-rates and complication profile needs to be validated in a larger patient cohort as well as after long-term follow-up.

A04 – HIP

The PAO As Successful Therapy For Hip Dysplasia And Acetabular Retroversion – Long-Term Results Of 35 Years Of Experience In 1044 Hips (9725)

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Background: Since its first description in 1984, the periacetabular osteotomy (PAO) has become the gold standard in the surgical treatment of hip dysplasia (DDH). Since 1997 the PAO is used for correction of acetabular retroversion (RV) as well.

Objective: The aim of this study was to calculate (1) long-term survival of the hip and (2) predictive factors for survival following all PAOs ever performed at the inventor's institution for DDH or RV.

Methods: We performed a retrospective case-series including 1044 PAOs between 1984-2019. Our follow-up-rate was 93%. 844 hips underwent PAO for DDH. The mean age at surgery was 29±10 (16–48) years. 30% had previous surgery. The mean follow-up for PAO in DDH was 14±9 (1-35) years.

129 hips underwent PAO for correction of RV. The mean age at surgery was 22±7 (16–45) years. Previous surgery was performed in 14%. The mean follow-up for PAO in hips with RV was 12±7 (1-22) years.

Survival was calculated with the endpoint of conversion to total hip arthroplasty (THA) using Kaplan-Meier-analysis. Preoperative demographic, clinical and radiographic data were evaluated and predictive factors for conversion to THA with corresponding hazard ratios were calculated with a Cox-regression-analysis.

Results: The survival rate of all PAOs performed for DDH resulted 50% at the 35-year follow-up. Out of 844 hips, 205 hips converted to THA after a mean of 14 (0.3-35) years. For the treatment of DDH, predictive factors for poor long-term outcome included age >40 years (hazard ratio [HR] 1.83; p <0.001), preoperative arthritis Tönnis grade ≥ 2 (HR 3.63; p <0.001) and previous surgery (HR 1.44; p=0.013).

The survival rate for PAOs for correction of RV was 93% at 22-year follow-up. Out of 129 hips 5 converted to THA after a mean of 11 (2-18) years. Predictive factors for conversion to THA following PAO for RV included arthritis Tönnis grade ≥ 2 (HR 7.12; p <0.001) or previous surgery (HR 4.16; p=0.008).

Conclusion: DDH and RV are two very different hip pathologies, which both can be treated successfully by PAO. Long-term survival rates differ with increased survival for correction of retroversion (93% at 22 years) compared to dysplasia (50% at 35 years). This is not only due to shorter follow-up time but also due to the RV-patients being younger and having less arthritis and previous operations, as those are the strongest negative predictive factors. Further negative predictors are in evaluation.

Geriatric Patients with Acetabular Fractures have a Higher One-Year Survival compared to Proximal Femoral Fractures: A Matched Case-Control Study of 486 Patients. (9736)

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Introduction: Due to demographic changes, the prevalence of geriatric acetabular fractures rises. Operative treatment is more complex compared to proximal femoral fractures and often does not allow full-weight-bearing. We asked: what are (1) the cumulative one-year-mortality rate, (2) perioperative complications, and (3) predictive factors associated with one-year-mortality following operative treatment of acetabular and proximal femoral fractures.

Materials and Methods: In this institutional review board (IRB) approved comparative study, 486 consecutive, surgically treated, elderly patients (136 acetabular and 350 proximal femur fractures) were included. Patients with proximal femoral fractures had significantly higher Charlson comorbidity and frailty indices, ASA scores as well as sarcopenia. We

therefore performed a case-control matching for the following factors: gender, Charlson comorbidity index, frailty and sarcopenia. Thus we obtained two comparable groups of 129 acetabular and 129 proximal femoral fractures. Cumulative mortality rates at one year were evaluated through Kaplan-Meier survivorship analysis; perioperative complications were documented and graded. After confirming that the proportionality assumption was met, cox-proportional-hazard modelling was conducted to identify factors associated with one-year mortality rates.

Results: The acetabular fracture group had a significantly lower cumulative one-year-mortality before (18% compared to 33% for proximal femoral fractures, log-rank p = 0.001) and after matching (respectively 18% compared to 36% log-rank p = 0.005). Nevertheless, they had a significantly higher overall perioperative complication rate (68% compared to 48%, p <0.001). In our multivariable cox-regression analysis, age, a perioperative blood loss >1L and wheelchair mobilization were associated with higher one-year-mortality after acetabular fracture surgery. For proximal femoral fractures, age and the 5 item modified frailty index were associated with a higher one-year-mortality, whereas full weight bearing was associated with lower one-year-mortality.

Conclusions: Despite the complexity of operative treatment and a higher perioperative complication rate for acetabular fractures in the elderly, the cumulative one-year-mortality is lower than after proximal femoral fractures, even after case-control matching.

The Fovea Capitis Moves Outside of the Fossa Acetabuli during Normal Range of Motion in Patients with Femoral Malversion; A 3D Based Motion Study (9753)

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Introduction: Lesions of the fossa-foveolar-ligamentous complex have been described in young patients undergoing hip joint preserving surgery, but the pathomechanism is unknown. We propose a new potential explanation for these lesions: the fossa-foveolar mismatch (FFM). It is defined by an overlapping contact of the fovea of the femoral head with the lunate surface of the acetabulum ("off the track") leading to an internal impingement of the ligamentum capitis femoris and related degenerative lesions. Based on our clinical, radiographical and intraoperative observations, we hypothesize that such a pathological tracking pattern is more frequent in patients with femoral malversion. The aim of this study was to compare the FFM-index in patients with excessive (deficient) femoral version during physiological range of motion.

Method: IRB approved three-dimensional (3D) motion study. Analysis of 110 hips with femoral malversion (88 excessive, 22 deficient) eligible for joint preserving surgery in our institution (2011-2020). Hips with Perthes, posttraumatic disorders, previous surgery and incomplete documentation excluded; 44 hips left for analysis (10 deficient and 34 excessive femoral version). Computed tomography based 3D models were segmented using the commercially available software AMIRA (Visage imaging Inc, Carlsbad, CA, USA). Virtual excision of the fossa acetabuli and marking of fovea capitis. Then analysis with validated 3D collision detection software. Using a standardized direct medial view on the resected FA and the transparent lunate surface, the FFM-index was calculated for the following motions: flex-/extension, ab-/adduction, and internal/external rotation. FFM-index: ratio between the fovea located outside of the fossa and the total foveolar tracking surface.

Results: While the deficient version group had a significantly higher proportion of foveolar tracking outside the fossa in internal rotation (median (range) 0.10 (0-0.28) compared to 0 (0-0.36); p=0.001), patients with excessive femoral version had a significantly higher FFM-index in external rotation (0.21 (0-0.43) compared to 0.14 (0.06-0.21); p=0.046). During flex-/extension and ab-/adduction the fovea was mainly located in the acetabular fossa in both groups.

Conclusion: Patients with femoral malversion present different patterns of foveolar maltracking. This could explain lesions of the ligamentum

capitis femoris and underlying hip pain in these patients and should be acknowledged in therapeutic decisions.

Registration Based Assessment of Femoral Torsion for Rotational Osteotomies based on the Contralateral Anatomy (9777)

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Background: Computer-assisted techniques for the treatment of femoral deformities have become increasingly important. In state-of-the-art 3D deformity assessment, the contralateral side is regularly used as a template for correction of the deformity. Therefore, an iterative closest point (ICP) algorithm is used for registration. However, the anatomical sections of the femur with distinctive features allowing for a consistent deformity assessment with ICP algorithms are not known so far.

The aim of this study was to find the sections with the smallest contralateral registration error and to compare these errors to the intra-individual difference in overall femoral torsion.

Material and Methods: 3D models were created from CT of 100 paired femurs without pathological anatomy. The femurs were divided into sections of eponymous anatomy. A surface registration algorithm was applied to superimpose these models onto the mirrored contralateral femur. We evaluated the 3D femoral contralateral registration (FCR) errors. They were defined as the difference in 3D rotation of the respective femoral section before and after registration to the contralateral side. The FCR errors were compared to the overall femoral torsion error, defined as the intra-individual difference in overall femoral torsion.

Results: FCR errors of the respective sections ranged from 0° to 9.3°. Among the sections, the FCR error using the proximal diaphyseal area for registration was larger than any other sectional error (mean 1.3°, range 0.1 – 5.1°). A combination of the lesser trochanter and the proximal diaphyseal area showed the smallest error (mean 0.6°, range 0 – 3.1°). The FCR error was smaller than the intra-individual difference in overall femoral torsion (mean 4.0°, range 0.1 – 13.0°) ($p < 0.001$).

Conclusion: If the contralateral femur is used as template, the built-in errors with the registration-based approach are smaller than the overall rotational error. The built-in errors are depending on the femoral section used for registration. For corrective rotational osteotomies a combination of the femoral section including the lesser trochanter and the proximal diaphyseal area showed the smallest error.

Gluteus Maximus Tendon Transfer for Severe Abductor Insufficiency – Clinical and MRI Results after a Minimum Follow-Up of 2 Years (9778)

Armando Hoch; Dominik Kaiser; Stefan Rahm; Reto Sutter; Patrick Zingg

Introduction: Severe insufficiency of the hip abductors can lead to pain and Trendelenburg limping. For these patients, gluteus maximus transfer is a surgical treatment option. So far, little is known about the clinical outcome and in particular the structural integrity of the reconstruction. Our hypothesis was that these patients benefit overall from surgery, with a positive impact on pain, but non-relevant improvement on hip abductor strength.

Methods: We investigated 8 (6 female, 2 male) consecutive patients who underwent a gluteus maximus transfer for severe insufficiency of the hip abductors in our institution from 01.01.2016 to 30.06.2018. After a minimum of 24 months follow-up, the patients were called in for a clinical and radiological examination including MRI of the hip abductors.

Pre- and postoperatively the pain level (visual analogue scale (VAS) 1 to 10), hip abductor strength (polio grade, M1 – M5), Trendelenburg sign and Trendelenburg or Duchenne limping were assessed. Integrity of the reconstruction, muscular trophy and fatty infiltration were analyzed on the pre- and postoperative MRI.

Results: Mean follow-up was 35 months (range 26 – 54). Pain level averaged 5.3 points (range 2 – 7.5) preoperatively and 2.5 points postoperatively (range 0 – 6.5) on a VAS ($p = 0.046$). The pain level decreased in

every patient ($p < 0.01$). Hip abductor strength did not significantly improve postoperatively (2.5 points preoperatively (range 2 – 4) and 3.1 points postoperatively (range 2 – 4); $p = 0.29$). Trendelenburg sign remained positive in all patients. Limping was present in 7 out of 8 patients preoperatively and in 3 out of 8 patients postoperatively ($p = 0.12$). There was no tear of the muscle transfer. Muscular trophy and fatty infiltration of the abductors and the transferred part of the gluteus maximus remained unchanged.

Conclusions: Gluteus maximus transfer for severe hip abductors lesions offers reliable pain relief after a minimum of 2 years follow-up. Muscle transfer integrity was confirmed in all cases. However, relevant improvement of muscle strength was seen only in 50% of the patients.

The Periacetabular Osteotomy: Angulation of the Supraacetabular Osteotomy for Intraoperative Navigation (9781)

Armando Hoch; Geraldine Grossenbacher; Anna Jungwirth-Weinberger; Tobias Götschi; Stefan Rahm; Philipp Fürnstahl; Patrick Zingg

Background: Periacetabular osteotomy enables for correction of acetabular orientation. Classic two-dimensional parameters on the conventional ap pelvic radiograph are being used for preoperative planning and verification of a satisfactory result. Acetabular reorientation is, however, a three-dimensional task and a simple, radiation-free intraoperative navigation and verification method that considers all three dimensions is highly desirable. The aim of the study was to find out whether the measurable angulation of the supraacetabular osteotomy can be used as an aid for this purpose.

Material and Methods: We investigated 13 consecutive patients who underwent a periacetabular osteotomy and for whom a standardized pre- and postoperative ap pelvic radiograph and a pre- and postoperative CT scan of the pelvis was available. Standard radiographic parameters (LCEA, ACI) were assessed pre- and postoperatively. 3D models were created from the pre- and postoperative CT scan and reorientation of the acetabular fragment was assessed three-dimensionally. A statistical analysis was conducted to correlate tilting and spreading of the supraacetabular osteotomy planes to the alteration of the standard radiographic parameters.

Results: Tilting of the supraacetabular osteotomy planes resulted in a significant alteration of the LCEA (Pearson correlation 0.74, $p \leq 0.01$) and ACI (Pearson correlation 0.803, $p \leq 0.01$), whereas spreading of the same planes resulted in a significant alteration of only the LCEA (Pearson correlation 0.939, $p \leq 0.01$). One degree of tilting resulted in 0.2° alteration ($p \leq 0.01$) of the LCEA and 0.5° alteration ($p \leq 0.01$) of the ACI, whereas one degree of spreading resulted in 0.5° alteration ($p \leq 0.01$) of the LCEA.

Conclusion: According to our 3D analysis, the measurable angulation of the supraacetabular osteotomy planes can be used to monitor the three-dimensional reorientation of the acetabular fragment in periacetabular osteotomy. As long as sophisticated modalities are lacking, this technique offers an easy way to intraoperatively navigate the correction in periacetabular osteotomy.

Deep learning for fully-automatic quantification of avascular necrosis of the femoral head on 3D hip MRI in young patients eligible for joint preserving hip surgery: A pilot study (9795)

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Introduction: Size of necrosis is an important prognostic factor in the management of femoral head necrosis (AVN), usually estimated on radiographs and MRI. Ideally, a fast-volumetric assessment of necrosis size

would be desirable. Thus, we evaluated a deep-learning method to automatically quantify the necrotic bone in AVN.

Methods: IRB-approved retrospective study of 34 patients (mean age 30 years, 14 women) with AVN according to the 2019 ARCO grading: I (negative x-rays): 3 hips; II (no fracture): 5 hips; IIIA (head collapse <2 mm): 14 hips; IIIB (head collapse >2 mm): 12 hips. Patients underwent preoperative 3T hip MRI including 0.8 mm³ 3D T1VIBE on which manual ground truth segmentation of necrosis was performed by an expert reader and then used to train a convolutional neural network (2D U-Net). A 3-fold cross-validation was performed between manual and automatic volumetric analysis of absolute/relative necrosis volume which was compared between early and advanced AVN (ARCO I/II versus IIIA/B). Mean difference between manual and automatic segmentation was compared with paired t-tests and correlation was assessed with Pearson correlation coefficients. We compared size the absolute and relative size of the necrosis between early and advanced stages of AVN (ARCO I/II versus IIIA/B) using Mann-Whitney U tests. A p value <0.05 determined statistical significance.

Results: Mean absolute and relative AVN volume was comparable between manual (8.2±7.4cm³, 17±15%) and automatic (7.3±6.7cm³, 15±14%) segmentation (both p >0.05) and showed a strong correlation (rp=0.90 and rp = 0.92, both p <0.001), respectively. Manual and automated segmentation detected a difference (both p <0.05) in relative necrosis volume between early and advanced AVN: 8±8% vs 20 ±16% and 7±8% vs 18±14%, respectively.

Conclusion: Applying a deep learning method for volumetric assessment of AVN is feasible and showed very strong agreement and enabled to distinguish early vs advanced disease stages which paves way for evaluation in larger datasets, with the goal to determine its prognostic value.

Subtrochanteric osteotomy in the management of femoral maltorsion results in antero-posterior malcorrection of the greater trochanter – computed simulations of 3-D surface models of 100 cadavers (9798)

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Background: Femoral maltorsion is associated with different hip disorders, i.e. femoroacetabular impingement or hip dysplasia, and may be addressed with subtrochanteric rotational osteotomy. Investigating femora with reduced antetorsion, previous studies suggested that a too posterior position of the GT might result after subtrochanteric osteotomies, explained by a compensatory increased posterior tilt of the greater trochanter (GT). The purpose of this study was to investigate the GT's behavior in simulated subtrochanteric osteotomy and quantify the GT's change in position in the axial plane.

Methods: Measurement of functional and anatomical femoral torsion, and position of the GT and lesser trochanter was performed using three-dimensional (3-D) surface models of 100 cadaveric femora. Femoral torsion between 2° to 22° was defined as normal, whereas femora with <2° and >22° of femoral torsion were assigned to the low- and high-antetorsion group. Subtrochanteric osteotomy was simulated to normalize torsional deformities to 12°.

Results: The compensatory posterior tilt of the GT was confirmed in femora with torsional deformity (R2 = 0.518, p = 0.016). With subtrochanteric osteotomy, functional antetorsion was simultaneously corrected while adjusting anatomical antetorsion (R2 = 0.866, p <0.001). Compared to the normal-antetorsion group, an antero-posterior (a-p) overcorrection of ±0.5 centimeter (cm) (range, 0.02 – 1.1) of the GT resulted in the high and low-antetorsion group, respectively (p <0.001): Mean a-p GT distance to a standardized coronal plane was 2.1 ± 0.3cm (range, 12 – 30) in the normal-antetorsion group compared to 1.61 ± 0.1cm (range, 1.4 – 1.71) and 2.6 ± 0.6cm (range, 1.8 – 3.6) for the corrected high and low-antetorsion groups, respectively. The extent of the GT shift in a-p direction correlated strongly with the extent to which anatomical femoral torsion was corrected (R2 = 0.946, p <0.001).

Conclusions: Despite reliable adjustment of anatomical and functional femoral antetorsion, subtrochanteric osteotomy for femoral maltorsion

resulted in an one centimeter a-p shift of the GT per 10° of torsional correction, and therefore overcorrection of the GT.

Fluoroscopy-guided vs. navigated iliosacral screw placement with intraoperative 3D scan or postoperative CT control: impact of the clinical workflow on radiation exposure (9799)

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Objective: Different techniques are known to guide and verify safe placement of iliosacral screws (ISS). Fluoroscopy-guided (FSG) ISS placement or 3D navigation have provided similar results.

Intraoperative 3D scanning following guide wire placement allows a correction of malpositioned guide wires during the same procedure and may replace postoperative CT. Thus, revision surgery may be avoided. However, higher radiation exposure for the conventional technique is a concern. It was the aim of this experimental study to evaluate radiation exposure for three clinical workflows.

Methods: An anthropomorphic, cross sectional dosimetry phantom, representing the body of a male human (173cm/73kg), was equipped with metal oxide semiconductor field effect transistors in various organ positions to measure organ specific radiation exposure. Each acquisition protocol was repeated three times to adjust the variability. The effective dose was calculated according to the guidelines of the International Commission on Radiological Protection. Radiation exposure was measured for FSG placement of 2 transverse ISS based on clinical experience regarding fluoroscopy time (lateral view 2 min; inlet and outlet views 1 min each). Additional measurements were conducted to calculate the effective dose for a 3D scan as used for navigated ISS (3D high-quality), for intraoperative verification of proper guide wire placement (3D standard-quality) and for postoperative CT, using a state-of-the-art scanner and protocol. The following workflows were compared: FSG including postoperative CT (FSG-CT) vs. FSG with intraoperative 3D scan (FSG-3D) vs. navigation including an intraoperative 3D standard-quality scan (NAV-3D).

Results: The effective dose for FSG-CT and FSG-3D were 5,12 mSv and 4.78 mSv, respectively. For NAV-3D, the effective dose was the lowest (3.00 mSv). The effective dose of a high-quality 3D scan required for navigation was 1.94 mSv, compared to 1.06 mSv for a standard-quality 3D scan. Radiation exposure of a standard-quality 3D scan was comparable to postoperative CT (1.06 vs. 1.40 mSv) with both counting for <40% compared to the effective dose for FSG ISS placement (3.72 mSv).

Conclusion: Intraoperative 3D scanning can be recommended, either combined with prior FSG ISS placement or following 3D navigation without increasing radiation exposure compared with alternative workflows with postoperative CT control.

Radiation exposure of 3 standard fluoroscopic views used in iliosacral screw placement: organ involvement and potential implications for the surgical technique (9800)

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Objective: Fluoroscopy-guided minimally invasive transverse placement of cannulated iliosacral screws (ISS) through S1 and/or S2 is an established technique to stabilize fractures of the posterior pelvic ring. Usually, three standard views (lateral (LV), outlet (OLV) and inlet (ILV)) are used. However, this technique may be associated with a considerable amount of radiation exposure. It was the aim of this experimental study to evaluate LV, OLV and ILV regarding effective dose and organ doses.

Methods: An anthropomorphic cross sectional dosimetry phantom, representing the body of a male human (173cm/73kg), was equipped with metal oxide semiconductor field effect transistors in different organ locations such as red bone marrow, liver, stomach, colon, gonads and bladder to measure radiation exposure. LV, OLV and ILV of the phantom were obtained with a mobile C-arm with three minutes of irradiation for each view. The acquisition protocol was repeated three times to adjust the variability. This data was used to calculate the effective dose and the organ doses according to the guidelines of the International Commission on Radiological Protection (ICRP).

Results: The effective dose was the lowest for LV (0.46 mSv/min) with about the double and fourfold amount of that for OLV (0.95 mSv/min) and ILV (1.85 mSv/min), respectively. For LV, the highest organ dose was found in colon (0.119 mSv/min), followed by red bone marrow (0.090 mSv/min). For OLV, colon (0.507 mSv/min) was also the most affected organ, followed by bladder (0.135 mSv/min). Regarding ILV, stomach showed the highest organ dose (0.918 mSv/min) and colon was also considerably affected (0.321 mSv/min).

Conclusion: Usually, the correct starting point of the guide wire is determined on LV. ILV and OLV are then alternately applied for a proper visualisation of the advancing guide wire. Based on our study, one should consider to advance the guide wire as far as possible exclusively guided by an exact LV to reduce irradiation with the guide wire aimed strictly in line with the central beam of LV. ILV and OLV may be used sparingly to confirm the correct wire position and to determine proper screw length. However, if the radiological anatomy of LV is considered not to be sufficient enough for a safe advancement of the guide wire, OLV and ILV may have to be used more often to improve safety despite higher radiation exposure.

Clinical outcome and patient satisfaction in patients with hamstring rupture treated with modified proximal surgical anchor refixation (9846)

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Introduction: Although repair of proximal hamstring rupture is a routine procedure, to date evidence regarding patient satisfaction and clinical outcome after refixation is scarce. We aimed to describe the clinical outcome and patient satisfaction in patients with a modified surgical technique 2 years after surgery.

Methods: This single center retrospective study included 9 patients (5 female, 4 male) treated surgically between 2016-2018 with a median age of 61.8 (range: 52.1–80.4) years and a follow up with median of 52.8 months (21.6-73.6). Eight patients had a complete proximal hamstring rupture and one patient a partial rupture (2 of 3 tendons) with at least 1 cm displacement. All hamstrings tendons were attached to the lateral aspect of the sciatic tubercle to improve the pretension and prevent local irritation over the sciatic tubercle. The clinical outcome included range of motion, muscle strength of individual muscle groups (M1-5, Janda), local tenderness on palpation and while sitting, and local skin sensitivity. Patients rated their satisfaction between 0 (not satisfied at all) and 100 (extremely satisfied). All data are presented as median (range).

Results: Maximum hip flexion did not differ between the operated and the non-operated hip neither with flexed knee (120 (115–120)°) nor with fully extended knee (operated hip 80 (60–110)°; non-operated hip 80 (70–110)°). Eight patients achieved full marks (L2-S1:M5/5) in clinical muscle strength and one only slight decreased M4/5; (female, 65 years, BMI 29.4 kg/m²). None of the patients felt any tenderness when palpated and all had normal sensitivity around the surgery scar. Patients were very to extremely satisfied with the treatment (100 (90–100)%).

Conclusions: Although reduced muscle strength of the hamstring muscles after surgical anchor refixation have been reported, patients in our study treated with more proximal/lateral surgical anchor refixation had excellent clinical muscle strength, less local irritation over the ischial tuberosity and most were extremely satisfied with the result after the surgery. While these results are very promising, further biomechanical studies are needed to measure isokinetic muscle strength and dynamic functional hip outcome.

Deep Learning Based Fully Automated 3D MRI Models of Hip Cartilage and Labrum: A pilot study (9874)

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Introduction: MRI has emerged as the modality of choice to assess hip joint damage. However, standard evaluation is based on 2D images. Ideally, 3D information of cartilage and labrum morphology from MRI would be available. However, manual segmentation for 3D reconstruction of cartilage and labrum is very time consuming and is therefore not routinely applied in clinical practice. Deep learning-based methods have the potential for automatic 3D segmentation of cartilage and labrum from hip MRI.

We aimed to validate a new deep learning-based method for automatic segmentation of cartilage and labrum against manual segmentation.

Methods: This IRB-approved retrospective study included 33 consecutive selected patients (34 hips) eligible for joint preserving hip surgery. Patients with previous surgery, trauma, childhood hip disease or avascular necrosis of the femoral head were excluded. The mean age in the patient series was 30 years (range 18 – 52 years) with 64% of female patients. All patients underwent a direct 3 Tesla MR arthrography including a high-resolution 3D T1 weighted sequence. Hips were assigned to 5 subgroups based on AP pelvic radiographs: hip dysplasia (lateral center edge angle (LCE) <20°; n=6), borderline dysplasia (LCE 20–25°; n=4), normal acetabular coverage (LCE 25–38°; n=12), deep hips (LCE >38°; n=5) and severe retroversion (n=7). 3D manual segmentations of cartilage and labrum served as training data for the neural network (2D U-Net) to obtain an automated 3D model of cartilage and labrum. A three-fold cross validation was performed and mean cartilage and labrum volume were compared between manual and automated segmentations. Correlations were assessed with Spearman correlation coefficient.

Results: Mean volumes were comparable for manual and automatic segmentation of cartilage (6887 ± 1319 mm³ and 7028 ± 1268 mm³, respectively) and labrum (volume of 2290 ± 1053 mm³ and 1976 ± 441 mm³, respectively). A very strong correlation between manual and automatic segmentation of cartilage (r = 0.88, p <0.0001) and labrum volumes was found (r = 0.81, p <0.0001).

Conclusion: This pilot study shows that deep learning methods allow automatic and accurate segmentation of cartilage and labrum based on 3D hip MRI. This validation highlights the potential for 3D assessment of cartilage and labrum in large data sets and paves way to routine use of these 3D MRI models of cartilage and labrum to potentially improve surgical decision making.

Management Of Pelvic Ring Injuries In High-Energy Trauma Patients: An Institutional Series (9885)

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Background: Pelvic ring injuries (PRI) in high-energy (HE) trauma patients with hemodynamic (HD) instability are complicated by a high mortality rate (up to 32%). Multiple management strategies for HD unstable PRI are described in literature, but there is no consensus for a standardized approach with the best patient outcomes. Since 2000, at our tertiary referral level I trauma center, a standardized protocol for HD stable and unstable HE PRI is applied. HD unstable patients not responding to pelvic belt, liquids administration and transfusions undergo urgent pelvic mechanical stabilization. If still HD unstable, angiography and potentially embolization are performed. The aim of this study was to evaluate mortality and outcome of the management protocol used at our institution.

Materials & Methods: The institutional severely injured patients' registry was reviewed to retrospectively collect demographic, clinical and radiologic data of a consecutive series of HE PRI patients treated from January 2014 to December 2019. Early and late mortality, mean packed red blood cell (PRBC) units need in the first 24 hours, intensive care unit (ICU) and hospitalization length of stay (LOS) were evaluated as outcome measures.

Results: We included 189 high-energy PRI patients, 121 HD stable and 68 HD unstable, whose mean age was 44.2 and 46.2 years, respectively.

The main cause of injury was a fall from height in the whole population. Most fractures were type B AO/OTA in unstable (54.4%) and stable (69.4%) patients. The mean ISS was higher for HD unstable (35.6) than stable (20.2) patients. There was a statistically significant difference in mortality between groups, with early mortality (<48hours) of 17.6% vs. 0% in unstable and stable patients, and late mortality (cumulative 60-day mortality) of 29.4 vs. 3.3% respectively. Unstable patients required a higher number of PRBC units (5.3 vs. 0.1 units for HD stable). The ICU and hospitalization LOS was 11.25 and 37.4 days respectively for unstable and 1.9 and 20.9 days respectively for stable patients.

Conclusions: In HD unstable patients, the protocol used at our institution shows a low early mortality rate (17.6%) and similar late mortality (29.4%) compared to the literature. Due to the variety of management protocols of HD unstable HE PRI patients reported in the literature, comparative studies are needed to determine the best management strategies according to patients' prognosis.

A Statistical Shape Model Based Analysis of (Reverse) Periacetabular Osteotomies – Technical considerations to achieve the targeted correction (9903)

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Introduction: The Bernese (Reverse) Periacetabular Osteotomy (PAO and rPAO) has been proven to be an effective surgical treatment for developmental dysplasia of the hip, severe acetabular retroversion and some protrusio acetabuli. In severe cases with higher degrees of correction, especially in reverse PAO, a relevant overlap between fragment and pelvis might occur and lead to a necessary fragment translocation possibly resulting in change of the rotational center. The aim of the present study was to analyze the necessary translocation as a function of the degrees of correction using a statistical mean model of the pelvis.

Methods: A mean statistical shape model was used to simulate a Bernese (reverse) PAO and calculate rotations from -20° to +20° in the frontal (FP), sagittal (SP) and transversal (TP) plane, and a combination thereof. Consecutively, the intersection depth and intersection volume between the mobilized fragment and the pelvis were calculated for each part of the pelvis and altogether. Thereafter, the minimal translation of the fragment necessary to avoid segment overlap was calculated.

Results: For PAO related rotations in case of dysplasia, the maximum intersection distance between pelvis and fragment was 6.5 mm for 20° FP rotation, 10.4 mm for 20° SP rotation, and 6.6 mm for combined 20° rotation in FP and SP. The necessary translation of the rotation center was 6.7 mm for 20° FP rotation, 8.0 mm for 20° SP rotation. The combination of both resulted in 6.0 mm inferio-lateral translation.

For rPAO related rotations in case of acetabular retroversion, the maximum intersection distance was 5.3 mm for 20° FP rotation, 26.9 mm for 20° SP rotation, and 28.1 mm for a combination of both. The necessary translation was 4.6 mm for 20° FP rotation and 18.6 mm for 20° SP rotation. The combination of both resulted in 17.7 mm translation.

Conclusion: Acetabular reorientation by the Bernese (Reverse) PAO results in translation of the fragment and in a consecutive change of the rotational center. This finding is more pronounced with higher degrees of fragment reorientation, becomes especially relevant in reverse PAO for femoroacetabular impingement or protrusio acetabuli and might limit the initial intention to overall improve hip biomechanics. Exact preoperative 3D planning of the desired position with specified fragment offset might be necessary to avoid negative impact on joint loading and leg length.

Total hip arthroplasty after osteosynthesis of proximal femoral fractures compared to primary Total hip arthroplasty (9908)

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Introduction: Total hip arthroplasty (THA) after proximal femoral fracture osteosynthesis (OS) is technically more demanding than primary THA.

Since poorer outcome has been reported, aim of the study was to describe intra- and postoperative complications and radiological outcomes compared to primary THA.

Methods: We conducted a retrospective single-center study of 85 Patients (25 male 65±13 yrs, 60 female 72±12 yrs) who have had THA (cTHA) after OS of proximal femoral fractures between 2009 and 2018. Patients were converted to THA after failed OS, nailing (n=52), cancellous screws (CS) (n=18) or sliding hip screw (SHS) (n=15). Reasons for conversion, intra- and postoperative data (duration of surgery, blood loss and adverse events) were recorded from our clinical information system. Radiographic outcomes (heterotopic ossification, sclerosis and osteolysis) were assessed pre-op, immediately post-op and 5 yrs post-op. Patient reported outcomes were collected. This gathered data then was compared with a cohort of 191 Patients (97 male 68±10 yrs, 94 female 70±13 yrs) with a primary THA (pTHA).

Results: The main reasons for conversion to THA was osteoarthritis (n=27), non-/mal-union (n=32) and cutout of the implant (n=10). The time between OS and THA ranged from 1 month to 47 yrs (median 1.08 yrs). 12% of the cases required a trochanteric refixation, 2.4% patients suffered an intra-op fracture that needed fixing. Heterotopic ossification, grade 3 and 4 (Brooker classification) were present in 4 cases. All patient reported outcomes showed a rapid progression between pre-op scores and 6 months and plateaued after 5 yrs FUP. Comparing the cTHA with the pTHA group we found longer time of surgery 113±33 minutes (cTHA) vs. 63±19 minutes (pTHA), furthermore blood loss was 473±300 ml (cTHA) vs. 323±180 ml (pTHA). In the cTHA group 12/85 (14%) had post-op adverse events compared to 34/384 (8.8%) of pTHA. The patient reported outcomes were similar in both groups.

Discussion: Our results show that conversion to THA after failed OS, is a more complex procedure than primary THA. The conversion is associated with longer time of surgery, intra- and post-op complications. We conclude that THA including removal of hardware after proximal femoral fractures is not correctly reimbursed in the Swiss DRG system.

Measurement of Lunate Surface Area of the Acetabulum with 3-D MRI and matched CT scans for patients with FAI (9964)

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Introduction: It is unclear if patients with pincer-type FAI with acetabular retroversion should be treated with an anteverting periacetabular osteotomy (PAO) or with acetabular rim trimming. The lunate surface area (LSA) is a new parameter for surgical planning. We aimed to compare the measurement of LSA and fossa acetabuli area (FSA) between 3-dimensional computed tomography (3D CT) and a novel segmentation approach for 3D magnetic resonance imaging (MRI) of patients with symptomatic femoro-acetabular impingement (FAI).

Methods: Twenty-six patients (31 hips, 48% men; age range 17-41 years) were consecutively evaluated who had both CT and MRI of the hip joint for evaluation of hip pain due to FAI. Inclusion criteria were patients with hip pain due to FAI who had both a 3D CT scan and MRI performed of the same hip joint. All patients had a positive anterior impingement test and underwent a 3-Tesla 3D MRI with additional volumetric 3D sequences and were retrospectively reviewed. Segmentation of patient-specific 3D models of the acetabulum were performed. En face views of the acetabulum for both CT and MRI were evaluated for patient-specific measurement of LSA and FSA with a custom-made software using a novel and fast technique. The size of the LSA was compared between two readers. Surgical treatment was performed in 19 hips and included cam resection and/or acetabular rim trimming in 12 hips with surgical hip dislocation or hip arthroscopy.

Results: There were no significant differences of the mean LSA measured by 3D-CT and (2227 ± 318mm²) vs 3D-MRI (2304 ± 340mm², p value 0.85). The mean LSA was not different among the manual 3D CT of two readers (2227 ± 318mm² vs 2185 ± 341 mm²). Overall regression

analysis demonstrated excellent correlation between CT and MRI for both LSA and FSA calculation ($r=0.95$, $p < 0.001$ and $r=0.901$, $p < 0.001$).

Conclusion: 3D MRI is nearly identical to 3D CT scans for measurement of LSA and FSA, making 3D MRI a reliable alternative for a preoperative evaluation. This is important especially for patients with acetabular retroversion. This study shows that a 3D MRI could be a radiation-free and reliable alternative to a pelvic CT scan.

Bone segmentation of the pelvis via tin-filtered ultra-low-dose CT compared with standard CT – A Feasibility Study (9972)

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Introduction: Computed tomography (CT) has made it possible to use patient-specific three-dimensional (3D) simulations obtained from medical image segmentation to assist preoperative planning, such as periacetabular osteotomies or subtrochanteric rotational osteotomies. However, radiation exposure of the pelvis is high when using standard CT. In this study, we evaluate the accuracy and quality of 3D-reconstructed models obtained from ultra-low-dose CT with tin filtration as an alternative to standard CT (gold standard).

Methods: IRB-approved prospective study with informed consent. Patients obtaining a non-contrast-enhanced standard CT of the pelvis were scanned additionally with tin-filtered ultra-low-dose CT of the pelvis. Both scans were used to create 3D surface model reconstructions of the left and right hemipelvis, and the left and right proximal femur. The reconstructions were performed for each patient independently by two readers. The root mean square error (RMSE) was used to calculate the average error between the surface models of both methods. Volume CT dose index (CTDIvol) and dose length product (DLP) were used as dose parameters. Differences in the radiation dose of both scans were evaluated using Wilcoxon signed-rank test.

Results: 23 subjects (9 males and 14 females; mean age 31 ± 8 years) were included. The mean average error for the right hemipelvis was 0.47 ± 0.06 mm (for the left hemipelvis: 0.48 ± 0.06 mm) for reader one, and 0.48 ± 0.07 mm (0.50 ± 0.11 mm) for reader two, respectively.

The mean average error for the proximal right femur was 0.52 ± 0.05 (for the proximal left femur: 0.5 ± 0.06 mm) for reader one, and 0.56 ± 0.08 mm (0.57 ± 0.11 mm) for reader two, respectively.

The average CTDIvol for the standard CT examinations was 8.19 ± 4.45 mGy, and 1.09 ± 0.02 mGy for tin-filtered ultra-low-dose CT exams, respectively. The DLP for the standard CT examinations was 220.45 ± 124.36 mGy*cm, and 29.12 ± 1.54 mGy*cm for ultra-low-dose CT exams, respectively. Comparing the radiation dose, the average CTDIvol and average DLP were substantially lower (-87 %) for ultra-low-dose CT with tin filtration compared to the gold standard ($p < 0.001$).

Conclusion: 3D surface model reconstruction from tin-filtered ultra-low-dose CT is feasible and has similar accuracy as that of the standard CT, though with a significantly lower radiation dose. This is of particular relevance for the young patient group undergoing an osteotomy of the hip.

Is the contralateral lesser trochanter a reliable reference for planning of Total Hip Arthroplasty – A 3-dimensional analysis (9978)

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Introduction: Preoperative templating in total hip arthroplasty (THA) is mandatory to achieve appropriate offset and leg length equality. However, templating methods using the contralateral hip might be susceptible to errors resulting from side-differences in the femoral morphology. The distance of the lesser trochanter to the femoral head center (LTFHD) is frequently used for preoperative planning as well as intraoperative validation during THA. However, currently no three-dimensional (3D) analysis of side differences of the LTFHD exists.

Methods: Computer tomography (CT)-based surface models were extracted from 100 paired femora (50 cadavers). Side-to-side asymmetry of the LTFHD, femoral length, femoral head diameter (FHD) and femoral antetorsion were analyzed. Univariate linear regression models were established to evaluate potential associations between sides regarding LTFHD and FHD as well as a correlation of these parameters with each other.

Results: Statistically significant side-differences were found for the LTFHD ($p = 0.02$) and FHD ($p = 0.03$). The mean absolute side-difference was 1.6 ± 1.4 mm (range $0.1 - 5.5$ mm) and 0.4 ± 0.6 mm (range $0 - 3$ mm) for the LTFHD and FHD, respectively. The ratio between the LTFHD and FHD was consistent with an average value of 1.16 ± 0.08 and reliable between sides with a correlation coefficient (r) of 0.72 ($p < 0.01$).

Conclusion: The LTFHD is a reliable reference parameter for preoperative templating and intraoperative validation during THA with a high correlation between sides ($r = 0.93$, $p < 0.01$). However, 8% of the investigated specimens revealed a LTFHD of more than 4mm, which should be anticipated during THA to avoid unsatisfiable results.

The Natural History of Degenerative Hip Abductor Tendon Lesions (9983)

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Introduction: Natural history of degenerative hip abductor tendon lesions remains unknown and has not yet been reported in the literature. The purpose of the present study was to assess the nonoperative clinical and structural outcomes of symptomatic patients with degenerative hip abductor tendon lesions.

Material and Methods: A consecutive series of patients suffering of greater trochanteric pain syndrome who underwent magnetic resonance imaging (MRI) of the native hip between January 2003 to November 2015 were identified. All 58 patients (64 hips, 40 females) with a mean age of 66y (range 37-91) were included in this study. Patients were called in after a minimum follow-up of three years (mean 74 months; range 38-138) for a clinical and radiographic examination including Harris Hip Score and MRI of both hips.

MRIs were evaluated for hip abductor tendinopathy, partial and full thickness tears as well as for fatty muscle infiltration (Goutallier, grade 0-4).

Results: On initial MR images, there were 14 hips without hip abductor tendon lesions, 15 tendinopathies, 32 partial tears and 3 full thickness tears. Fatty muscle infiltration averaged 1.3 Goutallier grade (range 0-4) and without significant correlation to the degree of tendon lesion.

On follow-up MR images, 15 hips had developed new hip abductor tendon lesions, but two tendinopathies healed. 6 tendinopathies (40%) progressed to partial tears. 2 partial tears (6%) progressed to full thickness tears. The 3 full thickness tears remained unchanged. There was no significant increase in fatty infiltration overall (1.5 Goutallier grade (range 0-4 $p=ns$)) and in hips showing progression of tendon lesions.

Compared to the asymptomatic contralateral hips at follow-up, there was significantly higher degree of degeneration of the lateral section of gluteus medius tendon ($p=0.034$) only, but without significant difference for fatty muscle infiltration.

At latest follow-up, mean HHS of the involved and asymptomatic contralateral hip was 80 and 93pts ($p < 0.001$), respectively.

Conclusion: Progression of symptomatic hip abductor tendinopathy to partial tears seems to be common after a minimum follow-up of 3 years. However, partial tears only rarely increase to full thickness tears. No relevant fatty muscle degeneration did occur in degenerative hip abductor tendon lesion at mid-term follow-up. These findings may support initial conservative treatment

ASEPTIC LOOSENING OF THE CEMENTED WEBER STEM IN PRIMARY TOTAL HIP ARTHROPLASTY – IS THE ANTERIOR APPROACH ASSOCIATED TO HIGHER RATE OF LOOSENING? A REGISTER-BASED RETROSPECTIVE ANALYSIS OF 483 CASES. (9993)

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Introduction: Aseptic loosening (AL) of the cemented stem is an important indication for revision after primary total hip replacement (THR). The reasons for this are not yet fully understood. Cementing quality, commonly classified by Barrack and Harris (BH), plays a significant role in this loosening and can be influenced by multiple factors. One factor includes bone quality, which can be evaluated according the Dorr classification (DC) and the Cortical Index (CI). Moreover, limited exposure of the proximal femur during minimally invasive anterior approach (MIS) is a common challenge in cemented THR.

The aim of our study was to identify an influence on cementing quality of the stem in MIS compared to the anterolateral approach (ALA) and therefore on the rate of AL. Also, we analyzed if body mass index (BMI) or patient's health status, described according the American Society of Anesthesiologists score (ASA), may play a role.

Body mass index (BMI) and health status, commonly described as American Society of Anesthesiologists score (ASA) were also analyzed to determine the influence they may have on outcomes.

Methods: Inclusions were cemented primary THR performed at our institution for degenerative hip joint disease between 2012 and 2019 according to the Swiss national registry for hip and knee replacement (SIRIS). We excluded fractures, conversion to THR after prior surgery or insufficient quality radiographs pre- or postoperatively. SIRIS and our own database were searched for revision THR for AL in our cohort. For all patients, surgical approach, BMI and ASA data were noted. DC and CI were measured in preoperative X-rays, while BH and the presence of radiolucency according the Gruen Zones were rated postoperatively.

Results: Among the 483 THR, 314 (65,1%) were performed through MIS and 169 (34,9%) through ALA. 14 out of 483 (2,9%) underwent revision due to AL. Mean interval to revision was 22,9 months (3,6- 45,9; SD: 45,9). Revision rate was greater for MIS (3,8%) compared to ALA (1,2%) but not significantly ($p = 0.1$). CI, DC and BH were not significantly related to revision ($p = 0,88$), ($p = 0,86$) and ($p = 0.48$), respectively. ASA and BMI were not significantly higher in the revision group ($p = 0,92$ and $p = 0,89$).

Conclusion: Our SIRIS based analysis of 483 primary cemented THR showed that MIS tends to cause a higher revision rate for aseptic loosening of the stem than the anterolateral approach. However, the association was not significant.

A05 – KNEE

The EOS 3D imaging system reliably determines posterior tibial slope (9717)

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Introduction: Planning total knee arthroplasty (TKA) prior to surgery is a mandatory step for success. In many centers routinely anterior-posterior (AP) and lateral standard radiographs of the knee and AP long leg radiographs (LLR) are available for this task. One of the preoperatively determined values is the posterior tibial slope (PTS), which is a proven factor for the success of TKA. It is best measured on CT or at least lateral full tibia radiographs which are routinely not available. Another option that is available in many centers is the EOS 3D imaging system, which provides an AP and lateral LLR with less radiation than a conventional LLR. Therefore, we aimed to investigate its reliability regarding PTS measurements.

Methods: We retrospectively reviewed our radiologic data base between 01/2019 and 12/2019 for patients with an EOS scan and additional rotational CT scan of the lower extremity. 56 knees were included for analysis. Medial and lateral PTS were determined on both EOS radiographs and CT scans. All Measurements were done independently by a radiologist and an orthopedic surgeon at two time points and intra-class correlation (ICC) was calculated to assess inter- and intra-reader reliability. Student's t test and the Pearson correlation were used to compare the results of both imaging modalities.

Results: The mean medial PTS was 8.5° (95% CI, 8.1-8.9°) on EOS and 7.7° (95% CI, 7.3-8.1°) on CT while the lateral PTS was 7.4° (95% CI, 6.9-7.9°) on EOS and 7.0° (95% CI, 6.5-7.4°) on CT. The inter-reader reliability (ICC) was excellent regarding medial and lateral tibial slope on EOS (0.880, 0.765) and CT (0.884, 0.887). The intra-reader reliability of reader 1 (ICC-range, 0.889 to 0.986) and reader 2 (ICC-range, 0.868 to 0.980) were excellent regarding the same measurements.

Conclusion: The EOS 3D imaging system provides reliable and reproducible tibial slope measurements compared to CT measurements as today's gold-standard. We recommend using this technique in preoperative TKA planning if available, because more information is gathered, compared to conventional LLR, with less radiation.

High inter- and intraindividual differences in medial and lateral posterior tibial slope are not reproduced accurately by conventional TKA alignment techniques (9721)

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Purpose: The purpose of this study was to describe the medial and lateral posterior tibial slope (MPTS and LPTS) on 3D-CT in a Caucasian population without osteoarthritis. It was hypothesised that standard TKA alignment techniques would not reproduce the anatomy in a high percentage of native knees.

Methods: CT scans of 301 knees (male:female = 192:109; mean age 30.1 (±6.1)) were analysed retrospectively. Tibial slope was measured medially and laterally in relation to the mechanical axis of the tibia. The proportion of MPTS and LPTS was calculated, corresponding to the "standard PTS" of 3-7°. The proportion of knees accurately reproduced with the recommended PTS of 0-3° for PS and 5-7° for CR TKA were evaluated.

Results: Interindividual mean values of MPTS and LPTS did not differ significantly (mean (range); MPTS: 7.2° (-1.0°-19.0°) vs. LPTS: 7.2° (-2.4°-17.8°), p=n.s.). The mean absolute intraindividual difference was 2.9° (0.0-10.8°). In 40.5% the intraindividual difference between MPTS and LPTS was >3°. When the standard slope of 3-7° medial and lateral was considered, only 15% of the knees were covered. The tibial cut for a PS TKA or a CR TKA changes the combined PTS (MPTS+LPTS) in 99.3% and 95.3% of cases, respectively.

Conclusion: A high interindividual range of MPTS and LPTS as well as considerable intraindividual differences were shown. When implementing the recommended slope values for PS and CR prostheses, changes

in native slope must be accepted. Further research is needed to evaluate the impact of altering a patient's native slope on the clinical outcome.

The Value of Proximal Transfer of Tibial Tubercle in Patients with Patella Baja after Total Knee Arthroplasty (9739)

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Introduction: One third of the patients after total knee arthroplasty (TKA) presents with anterior knee pain and impaired range of motion due (ROM) to patella baja. Proximal transfer of tibial tubercle is considered a satisfactory solution for this pathology. However, long-term follow-ups are lacking. We therefore aimed to investigate the clinical function as well as the radiographic patella height up to five years postoperative.

Methods: In a single-center study, sixty patients with patella baja after TKA that underwent proximalisation of the tibial tubercle were included. Clinical (ROM, Knee Society Scoring system (KSS), WOMAC questionnaire) and radiographic parameters (Caton Deschamps index (CDI), Blackburne Peel ratio (BP), modified Insall Salvati index (MIS)) were compared at various timepoints over the long-term follow-up.

Results: After a mean follow-up of 57 months, proximalisation of tibial tubercle resulted in a significantly improved ROM (80° vs. 88°). Whereas the KSS Knee Score did not improve postoperatively, patients showed worse results for both the KSS Function Score and the WOMAC questionnaire after the intervention. Immediately postoperative, the mean CDI and the BP were not significantly better than prior to the intervention (CDI 0.72 vs. 0.63; p=0.72 respectively BP 0.66 vs. 0.61; p=0.72) and even decreased significantly up to the last follow-up so that the mean final values were significantly worse compared to the native joint (CDI 0.59 vs. 0.78; p=0.001 respectively BP 0.58 vs. 0.74; p=0.001). Likewise, the MIS remained unchanged after proximalisation of the tibial tubercle compared to pre-intervention (1.59 vs. 1.55; p=1.00) and decreased further over the time so that the mean value at last follow-up was significantly lower compared to the native joint (1.39 vs. 1.81; p <0.001).

Conclusion: Proximalisation of the tibial tubercle in patients with patella baja does neither lead to a significant improvement of the clinical outcome nor of the radiographic patella height over the long-term follow-up. Through proximal transfer, the ROM can be significantly improved although not to a sufficient value for activities in normal daily life.

Autologous Matrix-Induced Chondrogenesis (AMIC) for Isolated Retropatellar Cartilage Lesions: Outcome After a Follow-up of Minimum Two Years (9775)

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Purpose: To evaluate autologous matrix-induced chondrogenesis (AMIC) for isolated focal retropatellar cartilage lesions and the influence of patellofemoral (PF) anatomy on clinical outcomes at a minimum of 2-year follow-up.

Methods: Twenty-nine consecutive patients (31 knees) that underwent retropatellar AMIC with a mean age of 27.9 +/- 11.0 years were evaluated at a follow-up averaging 4.1 +/- 1.9 (range, 2 to 8) years. Patient factors, lesion morphology and patient-reported outcome measures including KOOS, Tegner, Kujala score and VAS score were collected. PF anatomy was assessed on pre- and postoperative imaging, and subsequently correlated to outcome scores and failure to determine risk factors for poor outcome.

Results: At final follow-up, the AMIC graft failed in 4 cases (12.9%) at a mean follow-up of 21 +/- 14.1 months. Patients with failed grafts had a significantly smaller patellar and Laurins' PF angle than patients whose graft did not fail (p=0.008 and p=0.004, respectively). Concomitant corrective surgery for patellar instability was performed in 29 knees (93.5%). Grafts that did not fail presented with an average Kujala score of 71.3 +/- 16.9, KOOS of 68.7 and Tegner scores of 4.2 +/- 1.8. The

patellar angle was significantly associated with the patient's satisfaction level ($r=0.615$; $p < 0.001$).

Conclusion: AMIC for retropatellar cartilage lesions in combination with concomitant corrective surgery for patellar instability results in low failure rate with satisfactory clinical outcome and patient satisfaction of almost 80% at mid-term follow-up. Smaller patellar and Laurins' PF angle are associated with less favorable outcome.

Kaplan fibers injuries in acute ACL-deficient knees and ACL reconstructed knees – redefining the structure and risk assessment on routine MRI using injury patterns (9797)

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Background: The existing literature reveals ambiguity about the anatomy and radiological diagnosis of Kaplan fibers injuries in ACL deficient knees. To this date, there is no knowledge about the natural evolution of Kaplan injuries after ACL reconstruction.

Purpose: This study aims to evaluate a detailed injury pattern of knee joint structures along torn Kaplan fibers in ACL deficient knees and to further observe the healing process of the Kaplan fibers complex in ACL reconstructed knees.

Materials and methods: A total of 101 knee MRI scans obtained between January 2004 and April 2020 with acute full-thickness ACL tears were retrospectively assessed for visibility and impairment of three Kaplan bundles (proximal, distal and epicondylar band) and for associated knee joint injuries by two fellowship-trained independent musculoskeletal radiologists. Descriptive statistics and Spearman correlation coefficients ($p < 0.05$) were used to determine injury patterns. Based on the strongest correlations found with the other knee structures, a risk score was calculated. A subgroup of 33 follow-up knee MRIs after ACL reconstruction was assessed to observe the natural evolution of Kaplan fibers injury.

Results: Kaplan fibers were injured in 43% (43/101) of acute ACL deficient knees. Proximal Kaplan fibers were visible in less than 50% (48/101) of the knees as opposed to the distal Kaplan fibers and epicondylar Kaplan band which were both visible in 97% (98/101) of the knees. Injury to the Kaplan complex was significantly associated with anterolateral ligament ($p < 0.0001$), lateral collateral ligament impairment and BME on the extension facet of the medial femoral condyle ($p < 0.05$). After ACL reconstruction, the majority of Kaplan fibers (31/33) were healed with only two cases of torn and 13 cases of scarred distal Kaplan fibers, the other two bundles (proximal and epicondylar) being intact.

Conclusion: When examining the Kaplan complex in acute ACL deficient knees, injury patterns can firstly eliminate the uncertainty of proximal fibers identification and moreover can indicate the severity of the trauma during ACL rupture and orient the physician in actively searching for anterolateral and rotatory instability not only in the acute phase but also after ACL reconstruction.

Level of evidence: IV

Keywords: knee, Kaplan fibers, epicondylar band, anterior cruciate ligament, rotational injury, anterolateral instability.

Unicompartmental knee arthroplasty in outpatient setting: a group control study of 84 cases (9801)

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Introduction: The number of primary knee arthroplasties has been increasing and a key factor in its cost is length of hospital stay. Moreover, given the current pandemic situation, not overloading the hospital system is a priority. Outpatient surgery is a solution. Partial knee arthroplasty (PKA) in an outpatient setting (OS) is little described. The aims of this study are to evaluate the complications and re-admission rates within the first 30 post-operative days, as well as patients' satisfaction

and clinical scores post PKA in an OS and compare it to a control group of inpatients (IP).

Materials and Methods: This retrospective study includes all patients who underwent PKA in an OS and IP between 2014 and 2019 in the same institution. 84 PKA were performed in OS and 200 as IP. Complications and re-admissions within 30 days post-op were reported. Patient satisfaction was assessed using a satisfaction scale. Knee Society Score (KSS) was evaluated at the last control.

Results: In OS, two patients were re-admitted within 24 hours due to hematoma and uncontrolled pain, which did not require surgical revision. One patient had chronic knee pain at 2 years. In the IP group, one patient had a stroke 3 days post-op and one had pain due to conflict with the ACL spine and needed a revision surgery. In both groups over 90% were satisfied (93% in OS, 98% as IP, $p = 0.42$). The mean knee score of the KSS increased from 68.7 to 92.9 in OS and from 60 to 91.7 as IP and the mean KSS function score increased from 69.8 to 93.1 in OS and from 65 to 94 as IP, no statistical significance.

Conclusion: Our study demonstrates that performing PKA in an OS is safe. The clinical scores and satisfaction rate are comparable to the clinical scores of PKA performed in an inpatient setting. However, prospective comparative studies are needed to determine the risk factors that may affect the achievement of PKA in an OS.

Restoration of Native Leg Length After Opening Wedge High Tibial Osteotomy: An Intraindividual Analysis (9803)

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Introduction: This study aimed to assess the pre- and postoperative leg length of the involved lower extremity in patients submitted to opening wedge high tibial osteotomy (OWHTO) and compare it to the unaffected contralateral side. It was hypothesized that patients present with decreased preoperative length of the involved leg when compared to the contralateral side and that OWHTO would subsequently restore native leg length.

Methods: Sixty-seven patients that underwent OWHTO for unilateral medial compartment knee osteoarthritis that received pre- and postoperative full leg length assessment were included in this retrospective study. Patients that presented with varus or valgus deformity ($>3^\circ$) of the contralateral side were excluded. A musculoskeletal radiologist assessed imaging for the mechanical axis, full leg and tibial length of the involved and contralateral lower extremity. Statistical analysis determined the pre- and postoperative leg length discrepancy and the influence of the mechanical axis.

Results: The majority of patients (62.7%) presented with a decreased length of the involved leg with a mean preoperative mechanical axis of $5.0 \pm 2.9^\circ$. Length discrepancy averaged -2.2 ± 5.8 mm indicating a shortened involved extremity ($p=0.003$). OWHTO significantly increased the mean lengths of the tibia and lower limb by 3.6 ± 2.9 mm and 4.4 ± 4.7 mm ($p < 0.001$), leading to a postoperative tibial and full leg length discrepancy of 2.8 ± 4.3 mm and 2.2 ± 7.3 mm ($p < 0.001$ and $p=0.017$, respectively). Preoperative leg length discrepancy was significantly correlated with the preoperative mechanical axis of the involved limb ($r=0.292$, $p=0.016$) and the amount of correction was significantly associated with leg lengthening after OWHTO ($r=0.319$, $p=0.009$). Patients with a varus deformity of $\geq 6.5^\circ$ ($n=14$) presented with a preoperative length discrepancy of -4.5 ± 1.6 mm ($p < 0.001$) that was reduced to 1.8 ± 3.5 mm ($p=0.08$).

Conclusion: Patients submitted to OWHTO present with preoperative length discrepancy that is directly associated with the varus deformity of the involved extremity. As OWHTO significantly increases leg length, particularly patients with large varus deformity may benefit from native leg length restoration.

Influence of femoral tunnel exit on the 3D graft bending angle in ACL reconstruction (9812)

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Purpose: To quantify the influence of the femoral tunnel exit (FTE) in single-bundle anterior cruciate ligament (ACL) reconstruction on the graft bending angle (GBA) and GBA-excursion throughout a full range of motion (ROM).

Methods: 3D surface models of five healthy knees were generated from a weight-bearing CT obtained throughout a full ROM (0, 30, 60, 90, 120°) and femoral and tibial ACL insertions were computed. The FTE was simulated for 16 predefined positions, referenced to the Blumensaat's line, for each patient throughout a full ROM (0, 30, 60, 90, 120°) resulting in a total of 400 simulations. 3D GBA was calculated between the 3D directional vector of the ACL and the femoral tunnel, while the intra-articular ACL insertions remained unchanged. For each simulation the 3D GBA, GBA excursion, tunnel length and posterior tunnel blow-out were analysed.

Results: Overall, mean GBA decreased with increasing knee flexion for each FTE ($p < 0.001$). A more distal location of the FTE along the Blumensaat's line resulted in an increase of GBA and GBA-excursion of $8.5 \pm 0.6^\circ$ and $17.6 \pm 1.1^\circ$ /cm respectively ($p < 0.001$), while a more anterior location resulted in a change of GBA and GBA-excursion of $-2.3 \pm 0.6^\circ$ /cm ($+0.6 \pm 0.4^\circ$ /cm from 0-60° flexion) and 9.8 ± 1.1 /cm respectively ($p < 0.001$). Mean tunnel length was 38.5 ± 5.2 mm (range 29.6-50.5). Posterior tunnel blow-out did not occur for any FTE.

Conclusion: Aiming for a more proximal and posterior FTE, with respect to Blumensaat's line, reliably reduces GBA and GBA excursion, while preserving adequate tunnel length. This might aid to reduce excessive graft stress at the femoral tunnel aperture, femoral tunnel widening and promote graft-healing.

Impact of body mass index (BMI) on improvement of patient-reported outcomes after total knee arthroplasty (9825)

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Introduction: Total knee arthroplasty is known to successfully alleviate pain and improve function in endstage knee osteoarthritis. However, there is some controversy with regard to the influence of obesity on clinical benefits after TKA. The aim of this study was to investigate the impact of body mass index (BMI) on improvement in pain, function and general health status following total knee arthroplasty (TKA).

Methods: A single-centre retrospective analysis of primary TKAs performed between 2006 and 2016 was performed. Data were collected preoperatively and 12-month postoperatively using WOMAC score and EQ-5D. Longitudinal score change was compared across the BMI categories identified by the World Health Organization.

Results: Data from 1565 patients [mean age 69.1, 62.2% women] were accessed. Weight distribution was: 21.2% BMI < 25.0 kg/m², 36.9% BMI 25.0–29.9 kg/m², 27.0% BMI 30.0–34.9 kg/m², 10.2% BMI 35.0–39.9 kg/m², and 4.6% BMI ≥ 40.0 kg/m². All outcome measures improved between preoperative and 12-month follow-up ($p < 0.001$). In pairwise comparisons against normal weight patients, patients with class I-II obesity showed larger improvement on the WOMAC function and total score. For WOMAC pain improvements were larger for all three obesity classes.

Conclusion: Post-operative improvement in joint-specific outcomes was larger in obese patients compared to normal weight patients. These findings suggest that obese patients may have the greatest benefits from TKA with regard to function and pain relief one year post-op. Well balanced treatment decisions should fully account for both: Higher benefits in terms of pain relief and function as well as increased potential risks and complications.

ACL reconstruction in the pediatric population: A systematic review and meta-analysis (9855)

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Introduction: Given the increasing sport participation and level of competition among the young population, the incidence of anterior cruciate ligament tear has increased as well. Many techniques have been proposed to date, but there's not a clear consensus on which one is the best at a mid-long-term follow-up.

The aim of the current meta-analysis is to compare transphyseal against partial transphyseal and physeal sparing technique for anterior cruciate ligament reconstruction in order to assess the possible benefits or harms of these approaches.

Methods: A systematic literature search was performed on 18.02.2020 using PubMed, Web of Science, Cochrane library and Scopus literature databases. All human studies evaluating the outcome transphyseal, partial transphyseal and physeal sparing technique were included. Influence of the selected approach was evaluated in terms of rates of re-tears, return to previous level of sport, IKDC subjective and objective forms, Lysholm score, rate of normal Lachman and Pivot-shift tests, limb length discrepancy and hip-knee angle difference. Risk of bias and quality of evidence were assessed following the Downs and Black checklist.

Results: Forty-nine out of 425 studies matched the inclusion criteria. The results of the meta-analysis comparing physeal sparing vs partial transphyseal and transphyseal approach for ACL reconstruction in the under 20 population showed no significant differences between the three techniques in terms of subjective and objective outcome, growth malalignment differential laxity, rate of normal Lachman and pivot-shift tests and rate of normal/quasi normal IKDC objective score.

Conclusions: Unfortunately, the results of this meta-analysis cannot document a superiority of a specific surgical technique between PS, PT and CPT techniques among the considered outcomes. In particular, there is no statistically difference that shows a difference between the three techniques in growth malalignment and disturbances. Study design Systematic Review and Level 4 Meta-analysis

ROLE OF NADPH OXIDASE 4 (NOX4) IN THE PATHOPHYSIOLOGY OF OSTEOARTHRITIS (9935)

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Introduction: Osteoarthritis (OA) is a degenerative disease characterized by damage of articular cartilage, alteration of subchondral bone, and inflamed synovium. Articular cartilage is essentially composed of an avascular matrix produced by chondrocytes. In OA, articular cartilage follows a progressive degeneration, where low-grade inflammation plays a pivotal role through an oxidative stress-dependent mechanism and exposure to reactive oxygen species (ROS). In this study, we evaluated the role of NADPH oxidase 4 (NOX4) during experimental OA in mice.

Methods: Cartilage explants isolated from 9 weeks old femoral heads (wild type (WT) and NOX4^{-/-} mice) were cultured 72 hours with either PBS or IL-1 β to induce experimental OA ex vivo. Cartilage explants were then fixed with paraformaldehyde 4% and prepared for histology analysis. In vivo, OA was induced by destabilization of the medial meniscus (DMM) in WT and NOX4^{-/-} mice ($n=12$ for each group). At day 0, mice were radiographed using a microCT and operated. Eight weeks after surgery, mice were radiographed and sacrificed for histological analysis.

Results: Ex vivo, we demonstrated with safranin'O staining that NOX4 deletion protects from the loss of proteoglycans in the cartilage induced by IL-1 β . In vivo, histological analysis of the knee joint, 8 weeks post-surgery, demonstrated that DMM induced significant OA damages in WT mice. Large areas of cartilage destruction were observed with matrix loss and surface denudation as compared to sham-operated groups (OARSI score of 2.8 ± 1.2). A significant improvement was observed in DMM-NOX4^{-/-} mice with a reduced OARSI score of 1.5 ± 0.5 . We observed thicker cartilage, less osteophytes formation and less synovial

inflammation in DMM-NOX4^{-/-} mice as compared to DMM-WT mice. By micro-CT, we observed no differences at day 0 between WT and NOX4^{-/-} mice. However, 8 weeks after DMM, a slight increase was observed in the trabecular thickness (Tb.Th) and in the trabecular space (Tb.Sp) as compared to day 0, only in WT mice.

Conclusion: Our results demonstrated that NOX4 deficiency decreases cartilage degradation ex-vivo after IL-1 β stimulation and decreases significantly experimental OA severity in mice. Taken together these results underline that NOX4 could be a major target to dampen OA progression.

Distal femoral osteotomy for valgus knees: indications, technical aspects, clinical and radiological outcome (9955)

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Introduction: The aim of this study was to present the indications and technical aspects of medial closing and lateral opening distal femoral valgus osteotomy (MCDFO and LODFO) as well as to report complications, radiological and clinical outcomes.

Methods: Over 6 years 28 DFOs (22 MCDFO, 6 LODFO) were performed in 22 Patients: 6 bilateral, 16 f, 6 m, median (range) age 47 (17-63) y, height 1.68 (1.56-1.98) m, body mass 80 (49-105) kg, BMI 27.4 (18.6 -39) kg/m². Clinical outcome measures included complications, presence of pain at rest, during activities of daily living (ADL) and during physical activity, knee range of motion, patient satisfaction and need of unicompartmental or total knee arthroplasty (UKA, TKA) during follow-up time. Radiological outcome measures included time to union, presence of delayed or non-union as well as Kellgren-Lawrence (K/L) arthritis score, hip knee ankle angle (HKAA), mechanical lateral distal femoral angle (mLDFA) and mechanical proximal tibial angle (MPTA). The information was retrospectively extracted from clinical notes and radiographs and analyzed.

Results: The indication for DFO was degenerative valgus osteoarthritis (50%), posttraumatic arthritis (28%) and a combination of degenerative valgus osteoarthritis and patellar maltracking/instability (22%). The median (range) clinical follow up was 21 (7-81) months, the need for TKA/UKA was followed up for 59 (7-108) months postoperatively. Preoperatively, HKAA (- denotes varus) was 7.0 (2.0-13.0) °, mLDFA was 83.7 (79.9-88.2)°, and MPTA was 89.0 (86.6-94.5)°. Postoperatively, HKAA was -1.3 (-9.0-1.2)° and mLDFA was 90.8 (87.3-97.3)°. Four patients had a major and two a minor complication. The incidence of delayed and non union was 18% and 4%, respectively. At the last follow up 18 % had pain at rest, 25% during ADL and 39 % during physical activity, 71 % of the patients were satisfied with the outcome. One patient received a lateral UKA, one a bilateral patellofemoral UKA and one a TKA.

Conclusion: DFO is a reasonable treatment for lateral osteoarthritis in young patients to avoid disease progression and the need for an early UKA/TKA. However, there is a long rehabilitation time, a considerable risk for complications and a high need for hardware removal. While a great part of the patients experienced symptoms at the long term follow up, the majority were satisfied with the result of the operation. Appropriate patient selection and patient information is essential.

5-year failure rates of established and newer total knee arthroplasty implants: Meta-analysis of data from international registries (9967)

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HUG Hôpitaux-Universitaires-Genève

Introduction: Early Total Knee Arthroplasty (TKA) designs, such as NexGen or PFC, demonstrated their effectiveness and are considered as benchmarks. Recently, several new designs have been introduced. Our objective was to assess and compare 5 years failure rates in national and regional registries of established and more recent implants.

Method: From the International Society of Arthroplasty Registries (ISAR) website, we identified all national and regional registries reporting cumulative failure rates (CFR) (95% CI) at 5 years in their annual reports. We compared the CFR for the following implants: NexGen and Persona (ZimmerBiomet), PFC and Attune (DePuySynthes) and GMK Sphere (Medacta) stratified by constraint: Cruciate retaining (CR), posterior stabilised (PS) and medial pivot (MP). 5-yr revision-free survival probabilities reported by registries were combined using models with random effects (Der Simonian & Laird's approach). Amount of between registries heterogeneity was assessed with I² statistics and Cochran Q test for heterogeneity.

Results: Data from four national (SIRIS, Switzerland; EPRD, Germany; AOANJRR, Australia; NJR, UK) and one regional registry (RIPO, Italy) were included. Total numbers of implants/reports included were: NexGen CR 299186/7, PFC CR 297691/10, Persona CR 15971/3, Attune CR 37310/3, NexGen PS 154463/10, PFC PS 120649/8, Persona PS 16210/4, Attune PS 35692/4, GMK sphere MP 11003/5. 5-yr cumulative failure rates for CR systems were: NexGen CR 2.17 (1.85 to 2.54); PFC CR 2.90 (2.39 to 3.52); Persona CR 2.38 (1.64 to 3.44); Attune CR 2.63 (2.15 to 3.23). 5 yr cumulative failure rates for PS systems were: NexGen PS 2.93 (2.65 to 3.24); PFC PS 3.19 (2.60 to 3.91); Persona PS 3.56 (2.40 to 5.28); Attune PS 3.97 (2.50 to 6.28). For GMK Sphere MP it was 3.71 (2.60 to 5.27). The pooled 5-yr CFRs were 2.55% (95%CI 2.29 to 2.84) for all CR implants combined and 3.26% (95%CI 2.88 to 3.69) for all PS implants. The non overlapping confidence intervals indicate a statistically significant difference between the two.

Conclusion: At 5 years, CR implants had significantly lower failure rates than PS implants. NexGen CR had the lowest rate. Persona CR and Attune CR had CFRs similar to established implants. Among PS implants, NexGen showed lowest CFR. Persona and Attune had a CFR slightly higher than NexGen and PFC. CFR of GMK Sphere MP was similar to newer PS prosthesis and slightly higher than established PS implants.

Compressed Lateral and anteroposterior Anatomical Systematic Sequences (CLASS): Creating a Specific MRI Sequence with Identified Tibial and Femoral ACL Footprints (9988)

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Introduction: Both elite and amateur athletes are affected by anterior cruciate ligament (ACL) rupture. ACL reconstruction can improve knee kinematics and reduce the risk of secondary damage to the cartilage or meniscus, even if it does not prevent the early onset of osteoarthritis over the long term.

The aim of ACL reconstruction nowadays is to recreate the anatomic rather than the isometric footprints. The use of intraoperative fluoroscopy is thought to increase the tunnel placement's accuracy and reproducibility. Therefore, proper pin placement could be improved by patient-specific mapping of the anatomical footprints.

Using specifically developed MRI sequences, a precise definition of the anatomic footprint location on formatted anteroposterior and lateral views can be generated. Those MRI sequences would mimic standard X-Ray images, which can be used as a reference template for the intraoperative fluoroscopy.

This study's primary aim is to assess the feasibility of processing the MRI information with identified ACL-footprints into 2D-images similar to

a conventional anteroposterior and lateral X-Ray image of the knee. The secondary aim is to conduct specific measurements to assess reliability and reproducibility. This study is proof of the concept of this technique.

Material & Methods: Five anonymized MRI's of a right knee were analyzed using an Optima MR360 1.5T Advance. An orthopaedic knee surgeon performed the footprints identification. An ad-hoc software allowed a volumetric 3D image projection on a 2D anteroposterior and lateral view. This specific MRI sequence was named according to the acronym « CLASS » for "Compressed Lateral and anteroposterior Anatomical Systematic Sequences".

The intraclass correlation coefficient (ICCs), including 95% confidence intervals (CIs), has been calculated to assess intraobserver reproducibility and interobserver reliability.

Results: Five MRI's of a right knee have been assessed (three females, two males, mean age of 30.8 years old). Five 2D-"CLASS" have been generated.

The measured parameters showed a "substantial" to "almost perfect" reproducibility and an "almost perfect" reliability.

Conclusion: This study confirmed the possibility of generating 2D-compressed images with the localized femoral and tibial ACL footprints from a 3D volumetric model. The "CLASS" also showed that these footprints were easily identified on standard anteroposterior and lateral X-Ray views of the same patient.

Modifying stride length could enhance ambulatory knee kinetics of patients with medial knee osteoarthritis (9992)

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Introduction: Gait retraining is gaining in interest in the management of medial knee osteoarthritis (OA). Indeed, modifying the way of walking has the potential to alter the peak value (pKAM) and the impulse (iKAM) of the knee adduction moment and the peak value of the knee flexion moment (pKFM), three variables associated with the disease. Specifically, there is an interest in reducing the pKAM and iKAM without increasing the pKFM in patients with medial knee OA. Recently, a study in young healthy subjects showed that walking with shorter stride length (SL) could decrease the pKAM, iKAM and pKFM. Including SL modifications in rehabilitation protocols for medial knee OA could be quite straightforward. Therefore, there is a need to characterize the effects of walking with shorter SL in this particular population.

Methods: Fourteen patients with medial knee OA (8 males; 56.1±9.4 years old; 24.1±2.9 kg/m²) underwent gait analysis in a laboratory equipped with an augmented-reality system displaying instruction footprints on the floor. Their normal gait, as well as their gait at similar walking speed but with SL reductions of 15 cm, were recorded. Paired t-tests were used to compare the gait variables between the normal and modified conditions. Significance level was set a-priori at 5%.

Results: At the group level, walking with reduced SL resulted in a statistically significant decrease in iKAM (mean change of -8.6%, p=0.006), a trend toward reduction in pKAM (-6.5%, p=0.06), and no changes in pKFM (-3.5%, p=0.59). When walking with SL reduction, 36% of the patients actually reduced their pKAM and iKAM without increasing their pKFM.

Conclusion: This study confirmed the potential of SL modifications to enhance the mechanical environment at the knee joint in patients with medial OA. Similar to prior work about modifications in other footprint parameters, the responses were heterogeneous, suggesting that decreasing SL by a fixed amount will not become a universal solution for medial knee OA. The present study rather supports personalized gait retraining efforts where different modifications are recommended to different patients. Further research is necessary to characterize the effects of SL modifications of other magnitudes as well as the effects of SL modifications on the overall gait patterns, as this information will be crucial for proper inclusion of SL modifications in rehabilitation protocols for medial knee OA and potentially other pathologies.

Improved Sizing with Image based robotic-assisted system compared to Image-Free and conventional technique in medial Unicompartmental Knee Arthroplasty (9996)

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Background: Ideal component sizing is difficult to achieve in unicompartmental knee arthroplasty (UKA). Anatomic variants, incremental implant size, and a minimized surgical exposure may lead to over- or under-sizing of the components. The purpose was to compare the accuracy of UKA sizing with robotic-assisted techniques versus a conventional technique.

Methods: Three groups of 93 medial UKA were assessed. The first group was performed by a conventional technique, the second group with an image-free robotic-assisted system (Navio group), and the last group with an image based, robotic arm-assisted system, using on pre-operative CT scan (Mako group). There were no demographic differences between groups. We compared six parameters on postoperative radiographs to assess UKA sizing. Incorrect sizing was defined by an over- or under-sizing greater than 3mm.

Results: There was a higher rate of tibial under-sizing posteriorly in the conventional group compared to robotic-assisted groups (47.3% in conventional group, 29% in Navio group, 6.5% in Mako group; p <0.0001), as well as a higher rate of femoral under-sizing posteriorly (30.1% in conventional group, 7.5% in Navio group, 12.9% in Mako group; p <0.001). The posterior femoral offset was more often increased in conventional group, especially in comparison to the Mako group (43% in conventional group, 30.1% in Navio group, 8.6% in Mako group; p <0.0001). There was no significant overhang of the femoral or tibial implant in any groups.

Conclusion: Robotic-assisted surgical techniques for medial UKA decrease the risk of tibial and femoral under-sizing, particularly with an image-based system using a pre-operative CT scan.

Patients with a high daily activity level after knee replacement tend to have lower Forgotten Joint Scores compared to sedentary patients (10004)

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Introduction: The Forgotten Joint Score (FJS) is increasingly being used in outcome measurement after knee replacement, as it is known for a low "ceiling effect". However, the meaningfulness of the FJS in the short postoperative course has already been questioned, as also a high "floor effect" is described. Yet, no specific influencing parameters to the patients' self-assessment with the FJS are known.

In this context, the hypothesis of our study was that the individual level of activity has a higher impact on the FJS than the objective joint function in the early postoperative course.

Methods: 59 patients with the indication for total knee arthroplasty (TKA) (n = 33) or medial unicompartmental arthroplasty (UKA) (n = 26) were prospectively included in the study. All patients underwent robotic-arm-assisted knee replacement according to their indication. The Knee Society Score (KSS), the Oxford Knee Score (OKS) and the Forgotten Joint Score (FJS) were recorded preoperatively and 2 months postoperatively. All patients were also equipped with an activity tracker that recorded their daily step count for 4 weeks preoperatively and in the first 2 postoperative months. Based on their average daily activity in the 8th postoperative week, the patients were divided into activity categories and these were then compared with objective functional scores and the FJS.

Results: The UKA group was on average younger (64.25 y) and more active (6342 steps/day) than the TKA patients (67.33 y, 4876 steps/day) preoperatively. Also postoperatively the UKA group was always more active and mobility was built up 2 weeks faster, on average. The objective knee function measured with the KSS was significantly higher 2 months postOP for UKA compared to TKA (170 vs. 160 points), with almost identical OKS (34.2 vs. 36 pts.). The FSJ, however, shows a significantly better outcome for the TKA group (53 vs. 45 pts.). With regard to the individual activity, a negative correlation between the number of

daily steps and the FJS was seen, with the highest score in sedentary UKA patients (<5000 steps/day, FJS = 50 pts.) and lowest in active UKA patients (>10,000 steps/day, FJS = 41 pts.).

Conclusion: In the early postoperative phase after knee replacement, the FJS does not necessarily correlate with the the objective knee function or rehabilitation progress and should be interpreted with caution. It will be interesting to consider this relationship further over time.

Anatomical description of the medial and lateral femoral condyles vascular tree using polyurethane foam in cadaveric knees and potential clinical implication in Hoffa fractures (10017)

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Introduction: Bone vascular supply is a crucial entity that may lead to focal necrosis in case of disruption. A proper understanding of the vascular anatomy may improve surgical approaches by avoiding vascular iatrogenic insult. Hoffa fractures are described as intra-articular fractures of the femoral condyles, in the coronal plane. Different surgical approaches and fixation have been described but no consensus was found in order to significantly increase bone healing. This study aimed to describe the vascular tree of the distal femur and to highlight the safe zone for surgical procedures.

Methodology: Ten fresh-frozen knees were used to assess the vascularity around the femoral condyles. Industrial polyurethane foam was

used as casting material. After injection, the knees were bathed in a 10% NaOH solution. The corrosion process allowed all the soft tissue surrounding the knee to be subsided, leaving only the bone with polyurethane vascular architecture. An analysis of the vascular tree was performed in order to describe the vessels around the distal femur and deduce the potential disruption of the blood supply in cases of Hoffa fractures.

Results: The corrosion casting has shown a vascular network underlying the relationship of the vessels to the bone. Small periosteal arterioles with less than 1 mm in diameter were distinguished. One constant feature was notified, independently of the side of the knee; the nutrient vessel of the condyle (medial or lateral) emerges from the posterior side at the corner where the posterior cortex bend in the posterior direction. From this point, the artery follows an antero-distal direction at around 45° from a vertical line. This artery gives a variable number of vessels running posteriorly at an angle between 45° to 90°. On the medial side, an anastomosis from the nutrient artery with an anterior artery was found in 90% of the casts.

Discussion: This study provides a good description of the vascular network around the medial and lateral femoral condyles. This would allow a better understanding regarding the approach and fixation of Hoffa fractures by preventing further vascular damage.

Conclusion: This study confirmed the constancy of the medial and lateral distal femoral vascular tree. Because of this reproducibility, a proper anatomical approach may be planned for the surgical treatment of femoral Hoffa fractures. The implication of vascular rupture in the healing of these fractures still need further studie

A06 – FOOT

Fate of the Contralateral Foot in Charcot Arthropathy (9732)

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Background: The contralateral foot in Charcot neuroarthropathy (CN) is subject to increased plantar pressure. The clinical consequences of this pressure elevation are yet to be determined. The aim of this study was to evaluate ulcer and amputation rates of the contralateral foot in CN.

Methods: We retrospectively analyzed the medical records of 130 prospectively followed consecutive patients with unilateral CN. Contralateral CN development and recurrence, contralateral ulcer development, and contralateral amputations were recorded. Statistical analysis was performed to identify possible risk factors for contralateral CN and ulcer development, and contralateral amputation. Mean follow-up was 6.2 (SD 4) years.

Results: After a mean of 2.5 years, 19.2% patients developed contralateral CN. Female gender was associated with contralateral CN development (odds ratio 3.13, 95% confidence interval 1.27-7.7). Overall, 46.2% patients developed a contralateral ulcer. Among the patients who developed contralateral CN, 60% developed an ulcer. Sanders type 2 at the index foot (midfoot CN) was significantly associated with contralateral ulcer development. Ulcer-free survival (UFS) differed significantly between patients with diabetes type 1 (median UFS 5131 days) and patients with diabetes type 2 (median UFS 2158 days). A total of 25 amputations had to be performed in 22 (16.9%) patients. Three of those 22 patients (2.3%) needed major amputation.

Conclusion: Almost 20% of patients developed contralateral CN. Nearly half of people with CN developed a contralateral foot ulceration. Patients with type 2 diabetes had significantly shorter UFS than patients with diabetes type 1. Every sixth patient needed an amputation, with the majority being minor amputations. The contralateral foot should be monitored closely and included in the treatment in patients with CN.

Tibialis Anterior Tendon Reconstruction using either Autograft or Allograft: A Minimum 2-Year Follow-up with Functional Assessment and MRI Evaluation (9742)

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Background: In cases of tibialis anterior tendon (TAT) ruptures associated with significant defects, an interposition graft is needed for reconstruction. There is no consensus on the best graft choice, as data on outcomes is limited. It was the purpose of the current study to report on clinical, functional and imaging outcomes of both auto- and allograft reconstructions of the TAT. Our hypothesis was that both graft types would have a good integrity and provide comparable outcomes.

Methods: Patients who underwent TAT reconstruction using either an auto- or allograft were identified from the local database and invited for an interview. Patient-reported outcomes (PROs) were collected using the SF-12 questionnaire, the AOFAS hindfoot score, the Foot Function Index (FFI) and the Karlsson-Peterson score. Functional outcome was assessed using an isokinetic strength measurement protocol, including con- and eccentric assessment of foot inversion and eversion, as well as concentric ankle flexion and extension. Additionally, patients underwent non-contrast magnetic resonance imaging (MRI) for the evaluation of graft integrity. All measurements were also performed for the contralateral foot.

Results: A total of 21 patients with an average follow-up of 82 months (20 – 262), comprising 12 allograft and 9 autograft TAT reconstructions, were recruited. The follow-up was significantly longer in the autograft subgroup averaging 137 vs 41 months ($p < 0.001$). There were no significant differences in patient-reported outcomes between allograft reconstructions and autografts: SF-12 (30.7 vs 31.1, $p=0.772$); AOFAS (83 vs 91.2, $p=0.189$); FFI (20.7% vs 9.5%, $p=0.224$); Karlsson-Peterson (78.9 vs 87.1, $p=0.227$). All grafts (100%) were intact on MRI with a well-preserved integrity and no signs of new rupture. There were no major differences in ROM and functional outcomes. Also, the tibialis anterior

muscle (TAM) fatty infiltration was comparable between graft types when compared to the contralateral TAM.

Conclusion: In our patient cohort, reconstructions of TAT achieved good PROs, as well as functional and imaging results with a preserved graft integrity in all cases. There were no substantial differences between allograft and autograft reconstructions.

Functional Hallux Limitus: MR Imaging at the retrotalar pulley in patients with a positive hallux stress test (9767)Nils Reymond¹; Antoine Acker¹; Fabio Becce²; Jacques Valotton³; Mathieu Assal¹; Xavier Crevoisier⁴

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Introduction: Functional hallux limitus (FHLim) refers to a limitation of hallux dorsiflexion when the first metatarsal head is under load, while physiologic dorsiflexion is measured unloaded. Entrapment of the Flexor Hallucis Longus (FHL) in the retrotalar pulley has been identified as a possible cause of FHLim. One of the tests that identify FHLim is the stretch test. This test consists in applying dorsiflexion at the MTP 1 joint together with forced extension at the ankle, on a supine patient with extended knee. The test is positive when the MTP1 joint cannot be dorsiflexed.

To date, there is no published data about the association between clinical and radiological findings. The purpose of this study is to correlate the presence of FHLim, as identified with the stretch test, with MRI findings.

Methods: We performed the stretch test in patients who previously underwent ankle MRI. Patients presenting with any limitations of the MTP1 joint mobility in the resting position were excluded. Two groups were considered: A/patients with a positive stretch test; B/patients with a negative stretch test. MRI measurements were performed using 3D isotropic T2-weighted SPACE sequences reformatted in the sagittal and axial planes, with the ankle in the neutral position (90°) and included: 1. Distance from the retrotalar pulley to the most distal part of the FHL muscle belly on the sagittal reformat; 2. Cross-sectional area of the muscle belly at 2, 3 and 4cm proximally to the pulley on the axial reformat.

Results: We recruited 27 patients, 14 M and 13 F with a mean age of 44 years. 18 patients had a positive test while 9 patients had a negative test.

The mean length between the pulley and the muscle belly was 6.0 ± 6.4 mm for the positive group and 11.8 ± 9.4 mm for the negative group. (p -value 0.101)

The mean cross section of the muscle measured at 2, 3 and 4cm from the pulley were 190 ± 90 mm², 300 ± 112 mm² and 395 ± 123 mm² for the positive group and 98 ± 44 , 206 ± 72 and 294 ± 61 mm² for the negative group. (p -value 0.005, 0.076 and 0.068)

Conclusion: Even though the results are not statistically significant, there is a trend in the negative test group, with a muscle belly that ends more proximally and is smaller in all cross sections. Thus, showing that the pathogenesis of the FHLim could be correlated to an FHL entrapment in the pulley due to a lower and broader muscle belly. However, our study is limited by the small sample size and would need larger groups to verify these findings.

The Intra-Septal Course Of The Superficial Peroneal Nerve: An Anatomic Study (9884)

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Background: Anatomic and clinical studies show many variants of the superficial peroneal nerve (SPN) course and branching within the compartments and at the supra-fascial layer. The anatomy of the transition

zone from the compartment to the subcutaneous layer has been occasionally described in the literature, mainly in studies reporting the intra-septal SPN variant in 6.6-13.6% of patients affected by the SPN entrapment syndrome.

Despite the little evidence available, the knowledge of the transition zone is relevant to avoid iatrogenic lesions to the SPN during fasciotomy, open approaches to the leg and ankle, and SPN decompression.

Objectives: Our anatomic study aimed to describe the SPN transition site and to evaluate the occurrence of a peroneal tunnel and of an intra-septal SPN variant.

Study Design & Methods: According to the institutional ethics committee requirements, 15 fresh frozen lower limbs were dissected to study the SPN course and its branching, focusing on the transition site to the supra-fascial layer.

Results: The SPN was located in the anterior compartment in 2 cases and in the lateral in 13. An intra-septal tunnel was present in 10 legs (66%), at a mean distance of 10.67 cm from the lateral malleolus. Its mean length was 2.63 cm. The tunnel allowed the passage of the main SPN in 8 cases and of its branches in two. In the remaining 5 legs (33%), the SPN pierced a crural fascia window.

Conclusions: In our sample, a higher rate than expected of intra-septal SPN variants was found. The knowledge of the anatomy of the SPN course and intra-septal variant is relevant to avoid iatrogenic lesions during surgical dissection. Further studies are needed to evaluate the effective prevalence of an intra-septal tunnel in the clinical population, independently from the SPN entrapment syndrome, and how to avoid associated iatrogenic complications.

Patient specific instrumentation vs. standard referencing in total ankle arthroplasty: A retrospective comparison of accuracy (9911)

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Introduction: Earlier studies suggested that the use of patient-specific instrumentation (PSI) leads to more accurate implant positioning. However, the need of extensile periosteal stripping in the ankle joint debated to increase the risk for impaired osteointegration of the implants. The aim of this prospective study was to compare pre- and post-operative radiological and clinical outcomes between PSI- and conventional instrumented (CI) total ankle arthroplasty. It was hypothesised that the PSI-group would have more precise implant positioning, shorter operative time less perioperative complications but a higher rate of lucency lines on the postoperative radiographs.

Methods: 25 consecutive patients undergoing PSI-instrumentation were compared to 25 consecutive patients with CI-instrumentation. Outcome measures were peri-operative outcomes (operation time, wound healing) and post-operative radiological outcomes including the alignment of the tibial component, the tibio-talar tilt, and the talar offset on the sagittal view. Implant osteointegration was determined by the presence of radiolucent lines. Postoperative outcome was assessed at 3, 12 and 24 months postoperatively.

Results: In both groups a reasonable alignment for the majority of patients could be achieved with angles in the magnitude of 2° and deviations of more than 5° occurring in less than a quarter of the patients. No general advantage of one approach could be observed. The duration of the surgery did not show any difference between the two methods. Three patients showed radiolucency lines at the tibial component. One of them in CI group and two in the PSI group. Two patients presented with delayed wound healing (both CI group), however, none of them requiring secondary surgery or antibiotic treatment.

Conclusion: The PSI method did not show an advantage over CI in regard of positioning of the components or in the duration of the surgery. Radiolucent lines occurred in two cases after the use of PSI. However, the number of patients was too low to allow a statement on whether periosteal stripping adversely affects bony ingrowth of the implants. The authors conclude that PSI is a helpful tool in complex cases whereas no advantages over CI are to be expected in a standard total ankle replacement.

Treatment failure in Diabetic Charcot Osteomyelitis (9918)

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Introduction: Treatment of Diabetic Charcot foot osteomyelitis (DCO) is sophisticated as the challenges of Charcot foot deformity and Diabetic foot osteomyelitis (DFO) need to be incorporated into a single treatment approach. Data on the outcome of DCO is limited. The aim of this study was to describe the treatment outcome of DCO, and to compare treatment success of DCO with a reference cohort of DFO.

Methods: 623 episodes of DCO and DFO in 316 patients (73 females) were included. All episodes received a combination of surgical therapy (internal resection of osteomyelitis or minor amputation) and antibiotic treatment, non-surgically treated patients were excluded. Cox regression analyses were performed with the primary outcomes "clinical failure" (same location re-osteomyelitis within 12 months) and "major amputation". A Kaplan Meier curve was constructed to demonstrate the survivorship for the outcome of major amputation.

Results: 93 were DCO and 530 DFO episodes. Mean follow up was 3.4 years. Clinical failure occurred in 20 (21.5%) DCO episodes (22.3% in DFO episodes; ns). Microbiological failure occurred in 3 (3.2%) DCO episodes (6% DFO episodes; ns). Sanders type, presence of, and surgical correction of Rocker bottom deformity did not demonstrate a statistically significant association with clinical failure. Peripheral arterial disease (PAD) stages 3 and 4 (HR 6.1; 95% CI 2.0-18.1) and treatment with immunosuppressives (HR 7.4; 95% CI 2.0-27.1) were associated with clinical failure in DCO. Major amputations during follow up were significantly more frequent in DCO episodes (28% versus 13.6% in DFO; p < 0.001). Mean time to major amputation was 2.6 years. PAD stages 3 and 4 (HR 8.0; 95% CI 2.2-29.4), Smoking (HR 5.4; 95% CI 1.2-24.6), alcohol abuse (HR 3.5; 95% CI 1.1-10.6) and dialysis (HR 4.9; 95% CI 1.3-18.9) were associated with major amputation in DCO. The Log-rank test demonstrated a statistically significant association between Sanders types 3 (p=0.006) and 4 (p = 0.016) and major amputation.

Conclusion: Clinical and microbiological failure rates do not differ between DCO and DFO. However, patients suffering from DCO lose their limbs twice as much as patients with DFO over the clinical course. When advanced PAD stages are present, both clinical failure and limb loss must be expected. When a single DCO episode reaches remission, frequent clinical controls cannot be stopped due to the high risk of major amputation over the clinical course.

3D Assessment in Posttraumatic Ankle Osteoarthritis (9926)

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Introduction: Auto-generated 3-dimensional (3D) measurements based on weightbearing cone-beam computed tomography (CT) scan technology may allow for a more accurate hind- and midfoot assessment. The current study evaluated the reliability and clinical relevance of such measurements in patients with posttraumatic end-stage ankle osteoarthritis.

Methods: Seventy-two patients treated at our institution for posttraumatic end-stage ankle osteoarthritis, with available weightbearing conventional radiographs and a cone-beam CT scan, were analyzed. Twenty healthy individuals aged between 40 and 70 years served as controls. Seven variables were measured on the conventional radiographs (2D) and compared to 3D measurements that were based on reconstructions from cone-beam CT scans. The reliability of each measurement was calculated and subgroups formed according to commonly observed deformities.

Results: Inter- and intraobserver reliability was superior for 3D compared to 2D measurements. The accuracy of 3D measurements performed on osteoarthritic ankles was similar to 3D measurements performed on healthy individuals. Thirty-three of the 72 included patients (46%) evidenced an inframalleolar compensation of a supramalleolar/intra-articular

ankle deformity (78% = varus compensation; 22% = valgus compensation), whereas 24 of those 72 patients (33%) showed no compensation or a further increase of a supramalleolar/intra-articular ankle deformity (67% = varus deformity; 33% = valgus deformity).

Conclusion: Auto-generated 3D measurements of the hind- and midfoot are reliable in both healthy individuals and patients with posttraumatic end-stage ankle osteoarthritis. Such measurements may be crucial for a detailed understanding of the location and extent of hindfoot deformities, possibly impacting decision making in the treatment of end-stage ankle osteoarthritis.

High Reliability for Weightbearing CT Based Automated 3D Measurements to Assess Progressive Collapsing Foot Deformity (9927)

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Introduction: In progressive collapsing foot deformity (PCFD), hind- and midfoot deformities are paramount. However, an accurate assessment thereof, using weightbearing radiography, remains challenging. Automated three-dimensional (3D) measurements derived from weightbearing computed tomography (WBCT) scans may provide a more accurate approach for deformity assessment. In this study, automated 3D measurements based on WBCT were compared to two-dimensional (2D) measurements performed on weightbearing radiographs. Furthermore, it was investigated whether various stages of PCFD could be identified using automated 3D measurements.

Methods: Twenty patients treated at our institution with either a flexible (N=10) or rigid (N=10) PCFD were identified, retrospectively analyzed and compared to a control group of thirty healthy individuals. Four angles and two distances measured on weightbearing radiographs were compared to the automated 3D measurements derived from WBCT scans.

Results: In 5 out of 6 variables, the reliability of the measurements derived from weightbearing radiographs was lower than the automated measurements that derived from WBCT scans. The automated 3D measurements showed: the talar tilt in the ankle mortise was more valgus in patients with a rigid PCFD when compared to patients with a flexible PCFD; medial facet subluxation was present in all but one patient; patients with a sinus tarsi impingement evidenced a higher overlap between the talus and calcaneus (12.4±2.6 mm) compared to patients without impingement (7.8±3.9 mm; P=0.020).

Conclusion: A higher reliability of automated 3D measurements derived from WBCT scans, was evident for most variables when compared to measurements based on weightbearing radiographs. Besides being less prone to errors, automated 3D measurements may provide more reliable information regarding the hind- and midfoot alignment in patients with PCFD. Future studies may show to what extent 3D measurements could contribute to current diagnostic algorithms and treatment concepts of patients with PCFD.

Reduced preoperative deep saturation as measured by Laser Doppler spectrophotometry is associated with an increased rate of revision surgery after ORIF of calcaneal fractures through an extensile lateral approach (9969)

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Introduction: The extensile lateral approach to the calcaneus is still commonly used to surgically treat calcaneal fractures. However complications are high. These may occur due to impaired perfusion. Preoperative measurement of perfusion could help to decide on the best time point to operate these fractures.

We asked, (1) do the preoperative parameters of Laser Doppler spectrophotometry correlate with wound revisions after ORIF through an extensile lateral approach to the calcaneus, and (2) what are the sensitivity,

specificity, positive and negative predictive values of these parameters to predict wound revision after the aforementioned intervention?

Methods: All consecutive patients with calcaneus fracture who presented to a single Level 1 trauma center in central Europe were included in the study. This resulted in 37 hindfeet (34 patients). Patients were hospitalized to decrease swelling. After decision for surgery was made, a laser doppler spectrometry device was used to measure oxygen saturation, relative hemoglobin content and blood flow of the skin in 2 and 8mm depth at five different locations along the anticipated incision for the extensile lateral approach to the calcaneus.

Bi-partite correlation using Spearman rho analysis was performed. Receiver operator characteristics (ROC) curves were calculated to determine sensitivity, specificity, positive and negative predictive values.

Results: The minimal value of the oxygen saturation (SO₂) measurements of the five measurement locations in the deep layer as well as the minimal value for flow in the superficial layer correlated negatively with wound revisions (r= -0.367, p= 0.025 and r= -0.343, p= 0.038, respectively).

The area under the curve is 0.841 (95% confidence interval 0.64-1.00, p= 0.028) for preoperative minimal oxygen saturation in the deep layer to predict wound revision.

Discussion: A minimal oxygen saturation of 20.5% across the five measurement points at 8mm depth along the anticipated incision of the extensile lateral approach to the calcaneus have a sensitivity, specificity, positive and negative predictive value of 100%, 48.5%, 19%, and 100% to predict no wound revision.

Revision Surgery After Below Knee Amputations (9973)

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Introduction: Below knee amputations (BKA) are often the last option in surgical treatment for many medical conditions. Performing these radical interventions aim to balance between an amputation at the lowest level with the highest functional outcome and preventing subsequent higher level major amputations. Identifying risk factors could help to better inform patients and facilitate the surgeons' decision making.

What is the risk to undergo revision surgery after BKA (1) during same hospitalisation as primary intervention and (2) at later stage, and (3) what are risk factors for a subsequent higher amputation?

Methods: Retrospective review of all patients undergoing a primary BKA at one of three hospitals of the same public hospital group consisting of two level 2 rural hospitals and one level 3 main hospital between January 2009 and December 2019 resulted in 98 amputations. Cox regression analysis was performed to identify risk factors.

Results: 27% of all patients undergo revision surgery during the hospital stay in which the BKA was performed. 19% of all patients undergo revision surgery during a later hospitalization at a mean of 108 days (range 11-813 days). A third of these were higher level amputations (1 through knee and 5 above knee amputations).

When orthopaedic and trauma surgeons performed the primary BKA, age was negatively correlated with revision surgery (R= -0.391, p<0.001), female gender (R= 0.210, p= 0.037), higher serum creatinine and CRP levels (R= 0.208 and 0.325, p-values= 0.044 and 0.002, respectively) were positively correlated with revision surgery.

Conclusion: Approximately one quarter of all BKA needed a revision surgery during their hospitalisation for primary BKA. 6% of all patients had a secondary higher level amputation at a mean of 26 days (11-77). Correlating covariates "younger age" and "female gender" may be seen in relation to emotional factors deciding against primary higher level amputations.

The Role of Magnetic Resonance Imaging in Autologous Matrix-Induced Chondrogenesis for Osteochondral Lesions of the Talus (9989)

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Introduction: MRI imaging is the tool of choice for assessing articular surfaces after cartilage surgery. The MOCART score is a common tool for assessing regenerative cartilage tissue. The score was originally developed for use in the knee joint. Previous literature showed as a clear limitation with the lack of correlation of the score with clinical outcome after AMIC procedure for OLT. The aim of this study was to evaluate the now updated MOCART 2.0 score for use after AMIC procedure for OLT. This retrospective cohort study was approved by our ethics review board.

Methods: Patients who underwent isolated AMIC for symptomatic focal OLT between October 2009 and August 2015, had postoperative follow-up MRI imaging with same-day documentation of clinical scores (American Orthopaedic Foot and Ankle Society, AOFAS, and Tegner Score) were included. Patients with inflammatory arthritis and/or advanced osteoarthritis were excluded. Demographic, clinical, lesion-specific, and data regarding surgical procedure were documented.

Results: 35 patients could be included in the study. Mean: clinical and MRI follow-up was 4.5 ± 1.8 years, age was 34.4 ± 10.7 years and defect size was 0.9 ± 0.6 cm². Of the patients, 14 (40%) were female, 17 (48.6%) were smokers and 27 (77%) received a bone graft to fill the defect. The final AOFAS score was 92.63 ± 8.3 and the Tegner score was 5.1 ± 1.8 which significantly improved from 3.7 ± 2.0 ($p=0.002$). MOCART scores 1 59.0 ± 14.9 and 2.0 65.1 ± 13.9 correlated significantly with each other ($r = 0.885$; $p < 0.001$). Patients with shorter follow-up (< 4.5 years) showed significantly better MOCART 1 scores (64.7 ± 10.8 vs. 52.9 ± 16.6 , $p=0.02$) and tended to have better MOCART 2.0 scores (69.4 ± 12.4 vs. 60.6 ± 14.3 , $p=0.058$). However, analysis of MOCART 1 and 2.0 showed no correlation with clinical scores (AOFAS, Tegner).

Conclusion: By implication, the MOCART score decreases over time. Neither the MOCART 1 nor 2.0 score can give us clinically relevant infor-

mation, since the clinical outcome does not correlate with the radiological score. Thus, the MOCART 1 and 2.0 score does not play a relevant role in the treatment of symptomatic OLTs with AMIC procedure.

Talus morphology differs between flatfeet and controls, but its variety has no influence on extent of surgical deformity correction (10030)

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Background: In adult acquired flatfoot deformity (AAFD), there may be valgus angulation of the hindfoot in addition to a decreased arch. The aim of this study was to perform a 3-dimensional (3-D) analysis of the talus morphology between symptomatic AAFD patients that underwent operative flat foot correction and controls, and investigate if there is an impact on the success of operative correction.

Methods: We reviewed all patients that underwent lateral calcaneal lengthening for correction of AAFD between 2008 and 2018 at our clinic. Radiographic flatfoot parameters on preoperative and postoperative radiographs were assessed. Additionally, 3-D surface models of the tali were generated using computed tomography (CT) data. The talus morphology of 44 flatfeet was compared to 3-D models of 50 controls without foot or ankle pain of any kind.

Results: Groups were comparable regarding demographics. Talus morphology differed significantly between AAFD and controls in multiple aspects. There was a 2.6° increased plantar flexion (22.3° versus 26° ; $p=0.02$) and medial deviation (31.7° and 33.5° ; $p=0.04$) of the talar head in relation to the body in AAFD patients compared to controls. Moreover, AAFD were characterized by an increased valgus (difference of 4.6° ; $p=0.01$) alignment of the subtalar joint. Satisfactory correction was achieved in all cases, with an improvement of the talometatarsal-angle and the talonavicular uncoverage angle of $5.6^\circ \pm 9.7$ ($p=0.02$) and $9.9^\circ \pm 16.3$ ($p=0.001$), respectively. No statistically significant correlation was found between talus morphology and the correction achieved or loss of correction one year postoperatively.

Conclusion: The different morphological features mentioned above might be contributing or risk factors for progression to AAFD. However, despite the variety of talar morphology, which is different compared to controls, surgical outcome of calcaneal lengthening osteotomy was not affected.

A071 – PEDIATRIC ORTHOPEDICS

Clinical and radiological long term impact for the knee about a retrograde femoral approach after femoral intramedullary lengthening (9932)

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Introduction: Retrograde femoral approach is an established technique for implantation of nails for leg lengthening/ correction and cases of distal femoral fractures. We clinically and radiologically analyzed the long-term impact (>10 years) to the knee after leg lengthening via a retrograde femoral approach using a motorized nail in comparison to the non-operated contralateral knee.

Methods: In this prospective single-center study 13 patients with an average age of 17.4 years (15.3-19.5) were included who had unilateral retrograde femoral lengthening with a motorized nail performed at least 10 years prior to the initial operation (range 10 – 12 years). Patients were examined (gait, leg length, scars) and analysed with the SF 36, ISKD and Lysholm Score. Further 3T MRI of both knees of all patients were included. The MRI of the contralateral knee of each patient served as a control. The MRI were assessed for the presence and amount of any degenerative changes in the joint like signs of chronic synovitis, presence of cartilage defects (ICRS classification system) – each in comparison to the healthy contralateral knee.

Results: 8/13 postoperative knees showed a small amount of joint effusion. None of the postoperative or healthy knees showed signs of chronic synovitis. All postoperative knees showed fibrosis of Hoffa's fat pad, while no fibrosis was found in the control group. At least moderate to severe cartilage defects (Grade II-IV) of the trochlear groove were found in all postoperative knees at the original entry point. One healthy knee showed mild trochlear cartilage damage (Grade I). 6 of 13 of operated knees showed retropatellar cartilage defects, in 2 patients retropatellar cartilage defects were found on the contralateral side. 10 of 13 patients showed atrophy of the medial and lateral vastus muscle on the postoperative side in comparison to the healthy side caused by the lengthening procedure. All patients were pain free and showed full range of motion without deficit in comparison to the contralateral knee.

Conclusion: Retrograde femoral lengthening with a motorized nail about retrograde femoral approach can be associated with cartilage defects at the entry point, arthrofibrosis at Hoffa and atrophy of the quadriceps muscle caused by the lengthening procedure. Without corresponding clinical impairment these findings may be normal in long-term follow up.

Severe developing genu recurvatum in adolescence – the dark side of Osgood Schlatter? A review of 5 cases treated by gradual deformity correction and lengthening with the Taylor Spatial Frame (9986)

Hannes Manner; Rafael Velasco

Schulthess Klinik Zürich

Introduction: In general, Morbus Osgood Schlatter is a benign and well treatable condition in the adolescent knee. Only few cases are reported in the literature with increasing genu recurvatum due to premature closure of the anterior part of the proximal tibia physis as a sequela of severe Osgood Schlatter disease, when posttraumatic deformity and focal fibrocartilaginous dysplasia are excluded.

Methods: Between 2009 and 2018 4 male adolescents with 5 affected knees (1 bilateral case) were treated at our institution for severe increasing genu recurvatum. No trauma was evident in the past history. The average age at treatment was 14 years and 5 months. The right knee was affected in 3 cases, the left knee in 2 cases. The recurvatum deformity averaged 28° (range 26°-33°), a combined valgus deformity was present with 7° in average and a leg length discrepancy in the unilateral cases of 18mm in average. At least two of the cases were suspicious for focal fibrocartilaginous dysplasia. In all cases the anterior part of the proximal tibial physis was prematurely closed, while the posterior parts were still growing.

Results: All 5 cases were treated with the Taylor Spatial Frame for gradual lengthening and deformity correction in the proximal tibia. Simultaneously a permanent epiphyseodesis of the proximal tibia was performed to prevent recurrent deformity. Besides full restoration of limb axes, a mean lengthening of 26mm (range 10-35mm) was performed (mean overlengthening of 11mm) with the knowledge of prospective limb length at the end of growth. The average time in frame was 134 days (range 102-167) and days with partial weight bearing were 151 (range 124-181), resulting in a healing index of 58 days per cm lengthening. Complicationwise one premature consolidation of the fibula had to be treated surgically. All deformities were treated successfully with normal limb function at the latest FU.

Conclusions: Severe genu recurvatum deformity may result from premature closure of the anterior part of the proximal tibial physis. Besides Osgood Schlatters disease, focal fibrocartilaginous dysplasia may be the cause, when previous trauma is excluded. Treatment may be sophisticated but the Taylor Spatial Frame offers an ideal tool to address all underlying deformities.

Lengthening in Brachymetatarsia with an Internal Fixator (9987)

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Schulthess Klinik Zürich

Introduction: Brachymetatarsia is a rare disease. Even though the prevalence in boys is higher than in girls, the latter more often present with the wish of surgical correction due to cosmetic impairment as well as development of metatarsalgia.

Basically, if correction is desired, two methods are currently available: acute lengthening with interposition of bone graft and plating and gradual lengthening via an external or internal fixator. Only few reports are listed in the medline concerning the option of internal lengthening.

Methods: In the last two years (2019 and 2020) we carried out 5 internal lengthening procedures in brachymetatarsia with the Genos MT Mini. The interdigital lengthening handle is the only part outside skin level between the fourth and fifth toe. In comparison to external fixators the patient comfort therefore is much higher and well appreciated.

When the desired lengthening is achieved, the handle is removed, while the internal lengthening fixator is left in situ until full bony consolidation is seen on x-rays.

Results: We treated 5 feet with symptomatic brachymetatarsia of the 4th ray in 4 women (1 bilateral case) with an average age of 17 years. The left side was corrected in 3 cases, the right side in 2.

The average lengthening was 15 mm with a mean distraction time of 52 days. The mean lengthening speed was 0.3 mm/day. The time until full weight bearing was 86 days with an average healing index of 55 days/cm, while one patient is still in the consolidation phase with partial weight bearing. Only one internal fixator has been removed so far.

There were no complications or adverse events which influenced the procedure. The aim of the treatment was achieved in every case.

Conclusions: Internal lengthening offers a very safe and comfortable treatment for patients with symptomatic brachymetatarsia. Nevertheless they should be informed about the longterm partial weight bearing time until sufficient bony consolidation occurs.

The development of muscle strength after femoral leg lengthening – a 10 year follow-up (10006)

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Introduction: Leg lengthening by callus distraction leads to a loss of muscle strength. In a previous study we could show that muscle strength of the knee extensors 2 years after surgery is still decreased. We asked ourselves whether this is a short-term effect or whether this difference in muscle strength would be long-lasting. The present study

investigates the long-term effect of femoral lengthening on muscle strength with a minimum follow-up of 10 years.

Methods: Between 2007 and 2011 thirty patients with a median leg-length discrepancy of 3.0cm underwent femoral limb lengthening with an intramedullary motorized device. Maximum isokinetic, concentric torque of the extensors and flexors of the knee was measured with a dynamometer (Cybex Humac Norm®, CSMI Medical Solutions) before surgery (t1), as well as 2 years (t2) and 10 years (t3) after surgery. For the long-term analysis we included all patients with a complete dataset and a minimum follow-up of 10 years (n=9). We investigated the differences between preoperative and postoperative maximum isokinetic torques in the longer leg versus the shorter leg, as well as in comparison to a control group (dominant vs. non-dominant leg) of 10 healthy individuals with equal leg length.

Results: Before surgery the median maximum isokinetic torque of the extensor group was 16% higher in the normal leg compared to the

shorter leg. After leg lengthening the difference between the normal and the lengthened leg increased to 17.5% at 2-year follow-up and to 25.6% at the 10-year follow-up. In contrast, no alteration was found in the knee flexor group and there was no significant loss of maximum isokinetic torque in the lengthened leg (t1=2.4%; t2 = 5.7%, t3= 1%). In the control group the comparison between the dominant and the non-dominant leg showed a difference in the knee extensor torque of 2.9% as well in the knee flexor torque of 1.7% in favor of the dominant leg.

Conclusion: Muscle strength of the knee extensors after femoral leg lengthening does not recover in the long term. On the basis of the current study we suggest that the distraction of the muscle has a higher effect than previously thought. The alteration muscle properties might be a consequence of changes on the whole muscle level (length, width, depth), the fascicle level (length, orientation) and the fiber level (fiber damage, connective tissue proliferation). These are subject of ongoing research.

A072 – INFECTIONS

The Surgical treatment of infected forearm nonunions with a Medium-Size Bone Defect (9700)Mauro Maniglio¹; Ezequiel Zaidenberg²; Carlos Zaidenberg³¹ CHUV – Centre hospitalier universitaire vaudois; ² Italian Hospital of Buenos Aires; ³ Anatomy Department, School of Medicine, University of Buenos Aires

Introduction: In Infected nonunions of the forearm, authors mostly agree regarding the management of the infection. However, for cases with segmental bone defects, the reconstructive part of the treatment remains controversial. The induced membrane technique (IMT), has proven to have good results for reconstruction of nonunions and it is applicable to either aseptic and septic conditions leading to substantial bone loss. However, some surgeons advocate the use of vascularized bone grafts and reported satisfactory results with the use of the pedicled distal radius vascularized bone graft (VBG) for recalcitrant distal humeral and proximal ulnar nonunions. The purpose of this study was to compare the clinical and radiological outcomes of a series of patients treated for medium-sized bone defects in forearm nonunions with either the pedicled distal radius VBG, or the IMT.

Methods: Fourteen patients who underwent surgery for forearm nonunions with bone defects between 2 to 6 centimeters were retrospectively reviewed. Eight patients were treated using the VBG and six using the IMT. Mean follow-up was 42 months. The average number of previous surgeries in the VBG group was 5.1 and in the IMT group was 2.8. The average defect size was 5 centimeters in the VBG group and 4.6 centimeters in the IMT group. Elbow and wrist range of motion, Visual Analogue Scale (VAS) for pain, the QuickDASH questionnaire, and Mayo Elbow Performance Score (MEPS) were assessed. Complications and the need for reoperations were recorded.

Results: All nonunion were healed at final follow-up. The average time to union was 4.5 months (range 3-8) for the VBG group and 6.3 (range 5-11) for the IMT group. At final follow-up, the average VAS improved significantly from presentation to the latest follow-up in both groups. Quick-DASH and MEPS were respectively, 10 and 97 in the IMT group and 16 and 90 in the VBG group. There were three complications. In the VBG group, one patient required implant removal and elbow arthrolysis and in another secondary interventions to treat a wound infection were performed. In the IMT group, one nonunion required autogenous iliac crest bone graft due to a delayed union.

Conclusions: In this limited series, both techniques showed favorable results, and could be considered surgical alternatives for the treatment of forearm nonunions. Pedicled VBG showed a shorter time to union when compare with induced membrane.

The Impact of SARS-CoV-2 (COVID-19) Lockdown on Surgical Site Infections and other Complications after Orthopedic Surgery (9755)

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Background: In Switzerland, the SARS-CoV-2 (Covid-19) pandemic entailed a first lockdown phase restriction of elective orthopedic surgeries to emergency interventions. While access to the hospital and human contacts were limited, hygiene measures were intensified. The objective was to investigate the impact of those strict hygiene guidelines on the rate of surgical site infections (SSI), wound healing disorders and other complications after orthopedic surgery during the first Covid-19 lockdown.

Methods: In a single-center study, patients with orthopedic surgery during the first Covid-19 lockdown from March 21, 2020 to April 26, 2020 were compared to a cohort that underwent orthopedic intervention in the pre- and post-lockdown phase, respectively from October 1, 2019 to October 31, 2020. Adjusted multivariate analyses were used to investigate the occurrence of surgical site infections, wound healing disorders and other complications in all the three time strata.

Results: 5,791 patients were included in this study. After a mean follow-up of 7 months, the lockdown cohort showed a significant higher SSI rate compared to the pre- and post-lockdown period (2% versus 1% and 0.5%). The revision rate due to other complications was higher in the

pre-lockdown cohort compared to the others (5% versus 3%), whereas there was no difference for wound healing disorders between all cohorts. In multivariate Cox regression analyses, the lockdown phase was unrelated to all SSI (hazard ratio (HR) 1.6; 95% confidence interval (CI) 0.6-4.8), wound healing disorders (HR 0.7; 95% CI 0.1-5.7) and other complications (HR 0.7, 95%CI 0.3-1.5).

Conclusion: The rates for SSI, wound healing disorders and other complications in orthopedic surgery were not influenced by strict Covid-19 lockdown hygiene measures.

The influence of total and intravenous antibiotic therapy on remission in diabetic foot infections (9784)Florian Haug¹; Felix Waibel; Elin Winkler; Marcus Lisy; Ilker Uçkay; Madlaina Schöni¹ Universitätsklinik Balgrist

Introduction: The length of antibiotic therapy (ABT) in diabetic foot infections (DFI) remains a much-debated topic. Recent studies point out that shorter durations might not affect DFI remission. We investigate whether the length of systemic antibiotic treatment is associated with an enhanced risk of clinical or microbiological recurrences after therapy of DFI.

Methods: We collected data in 331 patients with a combined surgical-antibiotic treatment for DFI and minimal FU of 6 months; 79.8% were male, mean age 66 years. We grouped the length of ABT into 5 categories (0-7, 8-21, 22-42, 43-84, and >84 days), while the length of the initial intravenous antibiotic treatment was grouped into 4 categories (0-1, 2-7, 8-14 and >14 days). The reference was set at >84 days for total ABT and >14 days for parenteral ABT. Clinical failure (CF) was defined as need for surgery due to recurrent DFI at same situs within 12 months, microbiological failure (MF) as bacterial growth of at least 1 of 2 pathogens identified at the index surgery in revision surgery samples. We performed multivariate Cox regression to identify risk factors for CF and MF.

Results: We included 721 DFI episodes, 537 of them with osteomyelitis. 106 had DM type 1, 611 DM type 2. CF occurred in 26.5%, MF in 5.8% of the cases. The Cox regression showed that ABT of 8-21 days (hazard ratio 0.4; 95%CI 0.2-0.7) and 22-42 days (HR 0.5; 95%CI 0.3-0.9) were negatively associated with CF. For intravenous ABT, the short durations of 2-7 days (HR 0.5; 95%CI 0.3-0.8) and 8-14 days (HR 0.6; 95%CI 0.4-0.9) were also negatively associated with CF. In contrast, a prior contralateral minor amputation (HR 1.5; 95%CI 1.1-2.1) and status post PTA and/or arterial bypass surgery (HR 1.5; 95%CI 1.0-2.1) were risk factors for CF. No associations between the tested independent variables and MF could be detected.

Conclusion: Compared to prior long-standing total ABT of more than 84 days and intravenous therapy of more than 14 days, shorter total and intravenous ABT yield no enhanced risk of clinical or microbiological failure in debrided DFI episodes. Prior ipsilateral PTA or bypass surgery and contralateral minor amputation were identified as the most important risk factors for clinical failure in the treatment of DFI. Regarding the presence of substantial bias by indication, the best study designs in terms of the duration of systemic antibiotic use would be stratified prospective-randomized trials, which are under way.

Definition of long bone nonunion: A scoping review of prospective clinical trials to evaluate current practice (9861)

Matthias Wittauer; Marc-Antoine Burch; Martin Clauss; Willem-Jan Matsemakers; Mario Morgenstern

Aim: Although nonunions are among the most common complications after long-bone fracture fixation, the definition of fracture nonunion remains controversial and varies widely. The aim of this study was to identify the definitions and diagnostic criteria used in the scientific literature to describe nonunions after long-bone fractures.

Methods: A comprehensive literature search was performed in Pub-Med, Cochrane Library, Web of Science, and Embase. Prospective clinical studies, in which adult long-bone fracture nonunions were investigated as main subject, were included in this analysis. Data on nonunion definitions described in each study were extracted and collected in a database.

Results: Although 177 studies met the inclusion criteria, only 50% (88/177) provided a definition. Nonunion was defined in these studies based on time-related criteria in 82% (72/88), on radiographic criteria in 64% (56/88), and on clinical criteria in 43% (38/88). A combination of clinical, radiographical and time-related criteria for definition was found in 34% (30/88). The time interval between fracture and the time point when authors defined an unhealed fracture as a nonunion showed considerable heterogeneity, ranging from three to 24 months.

Conclusion: In the current orthopaedic literature, we found a lack of consensus with regard to the definition of long-bone nonunions. Without valid and reliable definition criteria for nonunion, standardization of diagnostic and treatment algorithms as well as the comparison of clinical studies remains problematic. The lack of a clear definition emphasizes the need for a consensus-based approach to the diagnosis of fracture nonunion centred on clinical, radiographical and time-related criteria.

Postoperative fever – Differences between elective vs. traumatic hip, knee and shoulder arthroplasty (9862)

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Introduction: It is unclear whether there is a difference in the incidence of postoperative pyrexia between hip, knee and shoulder arthroplasty. The influence of a trauma setting has not been established either.

Methods: A retrospective review was performed on 675 joint replacement surgeries (hip, knee or shoulder arthroplasty) in an elective or trauma setting over a two-year-period (2016 – 2018). Patient demographics and several perioperative and postoperative parameters were recorded. Patients with a postoperative fever (POF) were analyzed and the fever curve characterized. The results and costs of any fever-related diagnostic work-up were reviewed.

Results: A total of 89 patients (13.2%) experienced a POF $\geq 38.0^\circ\text{C}$, only 21 patients (3.1%) a POF $\geq 38.5^\circ\text{C}$. There was a significantly greater risk (OR 3.43) for POF $\geq 38.5^\circ\text{C}$ in trauma patients compared to elective arthroplasties ($p = 0.0062$) and in hip procedures compared to knee and shoulder arthroplasties ($p = 0.0091$). Patients experiencing POF $\geq 38.5^\circ\text{C}$ were more often males ($p = 0.003$), had an increased intraoperative blood loss ($p = 0.0295$), longer hospital stay ($p = 0.0028$). There was only 1/89 POF patients developing an early periprosthetic joint infection. The cost of a positive fever work-up (3/27 patients, 11.1%) leading to a new diagnosis and treatment was 2045 US\$.

Conclusion: POF $\geq 38.5^\circ\text{C}$ was more frequent in hip arthroplasty compared to shoulder and knee replacements, and more frequent in the trauma versus elective setting. The risk of developing an early periprosthetic joint infection was, however, not increased.

Treatment of fracture related infections in the SwissDRG-System – a retrospective cost-benefit analysis (9923)

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Introduction: Fracture related infection (FRI) is one of the most demanding complications in musculoskeletal trauma surgery. FRI's result in prolonged treatment duration and patient morbidity. FRI has been shown to at least double the median treatment cost. With healthcare systems under pressure, there is a great interest to take measures to control costs. This study aimed to assess costs and remuneration of FRI treatment in the context of the Swiss Diagnosis Related Groups System (SDRG).

Methods: We included 156 patients with a FRI treated at the University Hospital Basel between 2012-19 in a retrospective cohort study. The costs and remuneration according to the SDRG of each hospital stay

were evaluated. Clinical data including diagnosis and treatment details were collected. SDRG related data were obtained from the controlling department. Clinical and process related variables were examined for their influence on remuneration. The targeted length of stay (ALOS) was compared with the actual length of stay (LOS). Subanalysis for the different SDRGs were performed to analyze relative share.

Results: Mean costs/patient were 63'967 (SD 74'475) CHF while mean revenue was 58'059 (SD 65'926) CHF, resulting in a mean loss/patient of 5'908 (SD 30'724) CHF. The highest matter of expense was nursing and therapies with a relative share of 48%. This is also evident with the length of stay (LOS) being the main determinant of cost. Cost underfunding occurred in cases of polytrauma (-23.5%), involvement of the femur (-19.5%) and FRI related to fecal bacteria (-12%). Early orthoplastic flap coverage ($\leq 72\text{h}$, $n=10$) was more cost effective than late ($>72\text{h}$, $n=28$) ($p=0.077$). Average hospital stay was 1.4 times longer than targeted by the SDRG. Cases grouped into SDRG I12, which is specific for bone and joint infections, were covered consistently.

Conclusion: Our study indicates the enormous financial burden of FRI's. In our findings only a minor group of patients was responsible for the majority of uncovered costs. The complexity of FRI underscores the need of treatment at multidisciplinary centers with a combined infectious diseases-ortho-plastic approach. This may optimize overall treatment with reduced hospital stay and therefore reduce health care costs.

Perioperative empiric antibiotic treatment in patients with diabetic foot infections after amputation surgery is equally effective as directly targeted therapy (9931)

Arend Nieuwland¹; Felix Waibel²; Andreas Flury²; Martin Berli²; Ilker Uçkay²; Madlaina Schöni²

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Introduction: Optimal perioperative antibiotic therapy in patients having surgery for diabetic foot infections (DFI) is unclear. It is unknown, if clinically relevant differences between strictly empirical treatment, directly targeted therapy and switched from empirical-to-targeted therapy exist. The current study explores a large cohort of DFI, enquiring if perioperative empirical antibiotic treatment is equally effective as directly targeted therapy.

Methods: Retrospective cohort study of 716 episodes (565 new episodes, 151 revision episodes) in 332 patients with DFI undergoing minor foot amputations on 418 extremities between 1996 – 2018. Three different antibiotic treatment strategies (empirical, directly targeted and switch from empirical-to-targeted antibiotic therapy) were assessed concerning total remission, clinical failure and microbiological failure rates using cox regression analysis.

Results: Median follow-up was 4 years, ranging from 0 – 17.5 years (IQR 2 – 9 years). The majority of amputations involved forefoot amputations (88%). In 74.6% of the cases, osteomyelitis was the leading indication for surgery. 194 cases received empiric antibiotic therapy, 291 cases directly targeted therapy and in 231 cases a switch from empirical-to-targeted therapy was found. 75% ($n=534$) received intravenous therapy, broad-spectrum antibiotics were used in 69.5% of all cases. In 526 cases, remission was achieved. Clinical failure occurred in 190 (26.5%) cases, microbiological failure in 44 (6.1%) cases.

Cox regression analysis showed no significant effect of antibiotic treatment strategy on clinical failures. However, use of broad-spectrum antibiotics (Hazard Risk 1.823; 95% Confidence Interval 1.2 – 2.8) and presence of coronary heart disease (Hazard Risk 1.422; 95% Confidence Interval 1.0 – 1.9) identified as statistically significant. For microbiological failure, no statistically significant factors were identified.

Conclusions: There is no statistically significant better pharmaceutical treatment strategy in perioperative management of diabetic foot infections after amputation surgery identifiable. Empirical-to-targeted treatment shows similar effectiveness on all outcome parameters as directly targeted therapy. Rather than aggressive antibiotic therapy first with de-escalation over the treatment course, clinicians treating DFI are encouraged to continue to use empirical antibiotic therapy and switch to targeted therapy as microbiological results come in.

The Risks for Primary and Secondary Major Amputations in Relation to the Initial Anatomical Localization of Diabetic Foot Osteomyelitis (9933)

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Introduction: Diabetic foot osteomyelitis (DFO) is common in diabetic patients. Data on the association between the initial anatomical DFO location and ultimate major amputation are limited. We retrospectively analyzed a possible association between the initial DFO location and other variables on the incidence of major amputation.

Methods: We included 583 amputated episodes in 344 different patients, excluding conservative therapies of DFO. All received a form of amputation (internal resection, minor or major amputation) in combination with antibiotic therapy. To adjust for the large case-mix, we performed a multivariate logistic regression analysis with the primary outcome "major amputation".

Results: Among the 344 diabetic patients (78 females), DFO was located in the forefoot in 465 (79.8%), in the midfoot in 94 (16.1%), and in the hindfoot in 24 cases (4.1%). The mean clinical follow-up period after amputation surgery was 3.7 years. Overall, we performed a major amputation in 63 (10.8%) DFO episodes, of which 47 (8.1%) were due to

DFO as primary indication. Sixteen amputations were due to ischemia rather than infection, which we therefore excluded from further analysis. Among the 47 remaining major amputations, 22 (46.8%) were performed as the primary treatment, while 25 (53.2%) were converted into major amputations after failure of a prior minor amputation. Among this latter group of secondary major amputations, the DFO was located in the forefoot in 14/465 (3%), the midfoot in 8/94 (8.5%) and the hindfoot in 3/24 (12.5%); this in contrast to DFO localizations of the forefoot, midfoot and hindfoot in 8/465 (1.7%), 5/94 (5.3%) and 9/24 (37.5%) cases of primary major amputations. Overall, limb loss occurred in 4.7% of forefoot, 13.8% of midfoot and 50% of hindfoot DFO. In multivariate logistic regression analysis, only the initial midfoot DFO (odds ratio (OR) 2.8; 95% CI 1.1-7.3), a hindfoot DFO (OR 8.7; 2.5-30.3) or presence of peripheral artery disease (PAD) (OR 3.8; 1.1-13.2) were associated with a secondary major amputation.

Conclusion: While the majority of DFO occurred at the forefoot level, the percentage of limb loss increased the more proximal the DFO was located. Among those with conversion to secondary major amputations, an association of initial mid- or hindfoot DFO and the presence of PAD was seen. Therefore, mid- and hindfoot DFO need relentless aftercare and frequent clinical surveillance, especially in case of PAD.

A073 – TUMORS

Epiphyseal Lymphoid Infiltrates of the Knee in Adolescents (9882)

Lukas Urbanschitz; Christoph Agten; Marco Matteo Bühler; Marie Wetzler; Daniel Andreas Müller

Introduction: We observed three cases of adolescent patients with strikingly similar radiological and histological tumors, not previously seen at our sarcoma center, that identified as epiphyseal lymphoid infiltrates.

Methods: We present three adolescents with focal lesions of the distal femur that were shown to be benign aggregates of small lymphocytes and plasma cells of unknown origin. The patients were within the age of 12 and 14 years.

Results: All lesions presented with similar MRI findings and provided the same histopathological findings in the biopsy. Although all lesion increased in size, only 1 patient remained symptomatic and underwent subsequent tumor resection. To our best knowledge, tumor or pseudo-tumoral epiphyseal lymphoid infiltrates as seen in these 3 patients have not previously been described.

Conclusion: We recommend a biopsy to rule out a malignant tumor or an infection. Observation, without further invasive testing in asymptomatic patients is recommend until the resolution of the lesions. However, if a lesion becomes symptomatic, surgical resection should be considered.

The effect of neoadjuvant radiotherapy on surgical resectability, the volume and the necrosis rate of soft tissue sarcomas- a retrospective monocentric analysis (9922)

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Introduction: Soft tissue sarcomas of the extremities are a rare but often highly-malignant disease. The mainstay of treatment mostly includes extremity preserving surgical resection, which is often combined with pre- and or postoperative radiotherapy. Advantages of preoperative radiotherapy include facilitated planning, lower radiation dose and thus fewer long-term side effects. The goal of this study is to retrospectively assess the effect of preoperative radiotherapy on the tumor volume and if this change potentially facilitates surgical resection.

Material and Methods: A retrospective analysis of 51 patients who suffered from a localized soft tissue sarcoma of the extremity or the trunk was performed. All patients included were treated by neoadjuvant radiotherapy prior to surgical resection with curative intent and had an MRI before and after radiotherapy.

The volume of the tumor as well as the distance to anatomically relevant structures were measured prior and after neoadjuvant radiotherapy. Patient information was obtained from the files. Tumor type, characteristics and necrosis rate were obtained from the pathology report.

Results: At last follow-up (median 51 months (range 6-113)) 19 (37%) of the 51 patients were deceased. Recurrence-free survival was seen in 29 patients (57%); 3 patients suffered from a local or systemic recurrence at last follow-up. In total 7 patients (14%) suffered from local recurrence and 18 patients (35%) from a systemic metastasis, whereof all but one were lung metastases.

The minimal distance of the tumor to important neurovascular structures was not significantly influenced by volume reduction of the soft tissue sarcoma by neoadjuvant radiotherapy. In 24 patients (47%) the absolute volume of the tumor increased after radiotherapy, in 19 patients (37%) the volume decreased and in 8 patients (16%) the volume remained stable. High-grade tumors showed a significant increase in tumor volume ($p=0.03$). High grade tumors showed a significant greater necrosis rate than low grade tumors ($p < 0.001$).

Conclusion: A volume decrease of soft tissue sarcomas inflicted by neoadjuvant radiotherapy does not lead to a significantly increased minimal distance to critical neurovascular structures and thus does not potentially increase resectability. High grade tumors show a significant increase in tumor volume and a significantly greater necrosis rate than low grade tumors.

Patient specific 3D-printed guides in malignant bone tumor resection and reconstruction – analysis in 17 cases (10026)

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Introduction: Customized accurate tumor resection and individualized reconstruction is a challenging in treatment of malignant bone tumor. Three-dimensional (3D)-printing technique is now widely used in the resection and following reconstruction of malignant bone tumor, which included but not limited to tumor model, osteotomy guide and customized implant.

Methods: We retrospectively reviewed 17 patients, who underwent limb salvage surgery by using 3D-printed guide at a single center between August 2014 and October 2019. The median duration of follow-up was 26 months. Osteosarcoma (41.2%) were the predominant diagnosis. The functional outcomes were assessed by Musculoskeletal Tumor Society (MSTS) functional score. We also analyzed survival status, intraoperative data, reconstruction methods and complications.

Results: We totally performed 76 guided osteotomies on effected bone and on allograft in 17 patients. Reconstruction in 13 cases was performed with biological technique: allograft combined with autograft was used in 7 cases. 12 of 13 (92.3%) cases showed a good bone healing in both allograft and autograft. 1 of 13 (7.7%) cases had allograft necrosis. Additional intra-operative extracorporeal radiation was performed in 3 pelvic cases for reconstruction. 54 of 55 (98%) osteotomies achieved wide resection and negative margin. 1 osteotomy contaminated the tumor tissue because of the swing of sawing, but fortunately there was no recurrence and metastasis till now. All the cases had successful limb salvage result without amputation. At the latest follow up, the mean MSTS Score was 24 (range: 13-30), 12 patients alive with no evidence of disease, 1 patient alive with disease, 4 patients had died of disease and 5 years overall survival is 72.2%. Complications occurred in 9 patients, with wound healing disorder being the most common complication (4 patients).

Conclusion: The 3D-printed resection guide was easy to use and showed promise in the field of orthopedic oncology. It can not only used in primary malignant bone tumor personalized resection but also in shaping structural bone allograft in bio-reconstruction, which can achieve a safety surgical margin and individualized tumor resection at the same time.

A08 – BASIC RESEARCH

Spinal degeneration is associated with the mechanical characteristics of dorsal spinal ligaments (9868)

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Introduction: The ligamentum flavum (LF), the inter- and supraspinous ligament (ISL&SSL) and the intertransverse ligament (ITL) are relevant spinal structures for segmental stability. The biomechanical effect of degeneration and aging on their biomechanical properties remains largely unknown. The aim of this study was to assess the material properties of the ITL, ISL&SSL and LF and to correlate parameters of biomechanical function with LF-thickness, intervertebral disc (IVD) degeneration and age.

Methods: MRI- and CT-scans of 50 human lumbar segments (Th12-L5) were used to assess the ISL (acc. to Keorochana), the grade of IVD degeneration (acc. to Pfirrmann) and to quantify LF-thickness. The ITL, ISL&SSL and LF were resected in the neutral position of the spinal segment with a specifically developed method to conserve initial strain. Ramp to failure testing was performed (0.5 mm/s) to record initial tension, slack length, stiffness and ultimate strength. The relationship between the biomechanical characteristics and age and radiological parameters were analyzed.

Results: With aging, a significant reduction in initial tension ($r = -0.5$, $p < 0.01$) and ultimate strength ($r = -0.41$, $p < 0.01$) of the LF was observed, while the effect on LF-stiffness and the characteristics of the other ligaments was non-significant. IVD-degeneration was correlated with a significant reduction in stiffness ($r = -0.47$, $p = 0.001$; $r = -0.36$, $p = 0.01$) and ultimate strength ($r = -0.3$, $p = 0.04$; $r = -0.36$, $p = 0.01$) for the LF and ISL&SSL respectively, with a similar, but non-significant trend for the ITL and a significant reduction in initial tension ($r = -0.4$, $p < 0.01$) of the LF. Comparing Pfirrmann 2 to 5, this reduction was 40-80 % for stiffness 60-70 % for ultimate strength and 88 % for initial tension of the LF. ISL&SSL-stiffness between Kerorochana grade A and D differed significantly ($p = 0.03$), while all other comparisons were non-significant ($p > 0.05$). LF-thickness did not correlate with the biomechanical properties of the LF ($p > 0.05$).

Conclusion: Aging is primarily related to biomechanical changes to the LF. IVD-degeneration is related to a relevant reduction in stiffness and ultimate strength of the LF and ISL&SSL, with a similar trend for the ITL. The ISL-specific Keorochana-grading provides only minimal biomechanical information and LF-thickness does not provide biomechanical information.

A09 – QUALITY ASSURANCE

Outcome Measurement in Trauma Surgery with a Fracture Database and Clinical and Patient-Reported Outcome Measures (PROMs) (9715)

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Objective: Patient-Reported Outcome Measures (PROMs) gain growing attention. The Food and Drug Administration suggested in 2009 to have PROMs for every new treatment and technology. The use of PROMs was further promoted by the Patient Protection and Affordable Care Act of 2010 in the USA. Recommendations from other national and international organizations include the OECD's Project of Patient-Reported Indicator Surveys (PaRIS) and the International Consortium for Health Outcomes Measurement (ICHOM). Our development and initiation of a Fracture Database started early in 2018. We orientated our database on the role model of the Swedish Fracture Registry.

Methods: REDCap (Research Electronic Data Capture) is a web interface for a SQL (Structured Query Language)-Database. We used it to program the Fracture Registry. We collect data about demographics, diagnosis, treatment, adverse events, clinical outcomes, and PROMs. The PROMs are recorded with the Software 'Heartbeat ONE' vs. 6.15.4. Inclusion criteria are all patients with fractures of the upper and lower extremity, including the pelvis and multiple injuries, treated surgically. Excluded are all patients with fractures of the hand as mono-trauma and non-surgical treatment. We established questionnaire sets for each anatomical region. Every hospitalized patient is screened for inclusion criteria to get the baseline PROMs. Follow-up PROMs are collected at 3-months and 12-months in our outpatient clinic.

Results: In five months of collecting PROMs, we have evaluated 599 patients, 521 fulfilling the inclusion criteria. 329 (63%) questionnaire sets were completed. The mean time for answering the questions was 11-20 minutes. The input rate of 63% for PROMs accounts for the start of the process, with 22 (4%) patients being dismissed before answering the questionnaires. 93 (18%) patients denied participation. 52 (10%) patients were not able to participate (dementia, delirium). Other causes for missing data were language barriers (n=28; 5%), medical reasons like polytraumatized patients (n=4; 0.8%), and deceased patients (n=15; 2.9%).

Conclusion: Most Orthopaedic Trauma centers publish data about PROMs from surgically treated patients. Starting in the first quarter of 2021, we will include non-surgically treated patients. We have optimized the process of including patients. Our aim is a response rate of more than 80% within this year to get representing data.

Pain localization matters – Do pain locations and pain intensity correlate? (9842)

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Introduction: Orthopedic questionnaires are a common tool to assess pain intensity. A critical argument about pain intensity is its subjective character and that it cannot be objectivated. Pain locations on the body surface might be a new approach but have been poorly investigated. Dave et al. could demonstrate better outcome for TKA in patients with only knee pain compared to patients with pain at multiple sites (Dave et al., 2016). The aim of this study was to investigate pain locations on the body surface and correlate it with pain intensity.

Methods: Included were orthopedic patients with pathologies of large joints (shoulder, hip, knee) and/or spine. At each consultation the pain score and the pain locations on the body surface were assessed with a standardized patient questionnaire (paper and pencil). The locations were marked on a special 2.5dimensional figure with a front and back view.

Pain locations were classified with a grid of 111 elements representing defined regions on the body (e.g. thigh: trochanter, front, lateral, dorsal, medial). The mean symptom score was calculated, the number of locations with the 111-element grid and their frequency. To visualize the "symptom-streams" all figures were digitally superposed and analyzed (by TO and MP; ETHZ).

Results: 712 assessments were included completed by 348 patients (56% female, mean age 67,3 years). The mean symptom score was 28/100 and two thirds of the patients had a score between 10 and 40. In the mean 3 locations were marked (maximum of 23). 33% of all assessments had one, 23% two and 16% three locations. Female patients had more locations (3,3 vs 2,6; p <0.001). The five most frequent locations were: knee right (19%), knee left (19%), ventral right thigh (17%), sacrum (16%), lateral thigh left (15%). The digital views superposed demonstrated two combinations of "symptom streams": 1. sacrum, groin, thigh, knee and 2. neck, shoulder, arm. Up to 6 pain locations correlated positively with pain intensity (pearson's correlation r=0.997).

Conclusion: Pain locations can be analyzed with a grid of 111 clinically defined elements on the body surface. In orthopedic patients two thirds had up to 3 pain locations.

Pain location and pain intensity correlate up to 6 localizations with a high correlation coefficient. Symptom locations seem to have the potential to objectivize the "subjective" pain intensity.

POSTER

A01 – SHOULDER/ELBOW

Novel surgical technique of capsule-labral closure in the open Latarjet procedure (9750)Marko Nabergoj¹; Alexandre Lädermann²; Sidi Wang²¹ Valdoltra Orthopaedic Hospital; ² Division of Orthopaedics and Trauma Surgery, La Tour Hospital, Meyrin, Switzerland; Department of Orthopaedics and Trauma Surgery, University of Geneva, Geneva, Switzerland.

Surgical treatment of anterior glenohumeral joint instability can be challenging and carries the inherent risk of recurrent instability, dislocation arthropathy and postoperative loss of external rotation. We are presenting a novel and easy technique for combined reconstruction of anterior labrum and capsule, with concomitant reduction of the humeral head during anterior capsule reconstruction in open Latarjet procedure. Analogous to other techniques, the coracoid graft is fixed on anterior-inferior part of the glenoid between 3 to 5 o'clock position. However, for this technique, during the preparation of the coracoid, two additional transosseous holes are drilled through the coracoid below the acromioclavicular ligament attachment, where the released labrum is later attached. Additionally, during the reconstruction of the anterior capsule, while the operated arm is held in abduction and external rotation to avoid the postoperative deficit of external rotation, the humeral head is reduced in the center of the glenoid. By doing so, the inherent risks of residual micro-instability and dislocation arthropathy are believed to be decreased. Further studies are needed to clarify the long-term consequences of this novel surgical technique in the clinical setting.

Novel surgical treatment of an excessive medial clavicle resection (9751)Marko Nabergoj¹; Alexandre Lädermann²; Sidi Wang²¹ Valdoltra Orthopaedic Hospital; ² Division of Orthopaedics and Trauma Surgery, La Tour Hospital, Meyrin, Switzerland; Department of Orthopaedics and Trauma Surgery, University of Geneva, Geneva, Switzerland.

Medial clavicle excision is a rarely indicated procedure performed in different pathologies affecting the proximal part of the clavicle. Excessive medial clavicle resection with an injury to the costoclavicular ligament often leads to poor postoperative results. The exact surgical treatment that should be used in this kind of pathology when conservative treatment is unsuccessful remains questionable. Our preferred surgical treatment of this condition is to fix an autograft from the iliac crest on the medial end of the clavicle with a plate. Stabilization of the newly reconstructed medial part of the sterno-clavicular joint is performed with a gracilis allograft shuttled through the medial part of the autograft and the lateral sternal part of the sterno-clavicular joint in a figure-of-eight configuration. The final costoclavicular stabilization reconstructing the costoclavicular ligament is performed with the high-strength sutures passing through the first rib and around the plate fixed on the remnant of the medial clavicle and multiple knots are performed on the superior surface. The end result is an anatomic reconstruction of the sterno-clavicular joint. Further long-term studies should show, whether the proposed surgical reconstruction and stabilization adequately restores normal shoulder mechanics and function, in the setting of symptomatic excessive medial clavicle resection.

Extended anterior approach to the humerus shaft – Cadaveric Study (9766)Philipp Birchler¹; Karl Grob¹; Kay-Bernd Lanner¹ Kantonsspital St. Gallen KSSG

Introduction: Selection of surgical approach for humeral shaft fracture depends on fracture location. Extended anterior approach to the humerus is difficult because neurovascular structures converge on the anterolateral aspect of the elbow. Many surgeons are unfamiliar with the specific anatomical features of this region. The purpose of the present study was to clarify the anatomy of the anterior approach to the entire

humerus and to investigate how far distally an anterior plate can be placed safely without jeopardizing neurovascular structures.

Methods: An extended anterior approach was performed on 30 cadaveric upper arms. A plate was adjusted helically to the entire humerus from the greater tuberosity to the coronoid fossa. Distally, the plate was placed underneath the brachialis muscle. Thereby, brachialis splitting was limited to the plate holes by blunt dissection. At determined levels, distances from the plate edges to adjacent neurovascular structures at risk (musculocutaneous nerve (MCN), lateral antebrachial cutaneous nerve (LACN), radial nerve, median nerve and brachial artery) were measured. The innervation pattern of the brachialis muscle was revealed and the potential risk of its denervation during surgery was analysed.

Results: Safe anterior plating of the entire humerus without damage to neurovascular structures occurred in all 30 specimens. Where the radial nerve pierced the lateral intermuscular septum its distance to the plate was >1.7cm. On the level of the coronoid fossa safe plate distances were: ≥1.1cm for the radial nerve, ≥1.4cm for the LACN, and ≥1.7cm for the median nerve and brachial artery. The brachialis muscle showed in 90% a dual innervation by the MCN and the radial nerve. The brachialis muscle regularly consisted of 3-4 intramuscular crossing neurovascular pedicles. The most proximal pedicle was always heavy-calibred and constantly found in all specimens.

Conclusion: Extended anterior approach to the entire humerus can be safely performed. Identification of the brachialis muscle crossing neurovascular pedicles may prevent damage to muscle innervation. Since the radial nerve runs at a safe distance to the helically shaped plate, identification is not compulsory. Anterior plate osteosynthesis of the humerus represents an advantageous alternative to the posterior or two incision approaches to the humerus.

Transhumeral amputation in brachial plexus lesion patients. A multicenter case series. (9836)Stijn de Joode¹; Martijn Schotanus²; Lodewijk van Rhijn³; Steven Samijo²¹ Spital Grabs, Switzerland; ² Zuyderland Medical Center; ³ Maastricht University Medical Center

Introduction: A flail limb can be the result of a traumatic complete brachial plexus lesion. An elective amputation has a place in the rehabilitation, however long-term follow-up is unknown. The aim of this study is to evaluate the outcome of this rare and life changing operation 10 years postoperatively.

Methods: 8 Patients with a mid-humeral amputation executed in 2 specialized medical centers were included. Psychological disorders were ruled out and all patients had a persisting wish for amputation. Postoperatively, the functional- and psychological outcome and the quality of life was evaluated with PROMs and standardized questionnaires (DASH, SIP-68, EQ-5D-5L and HADS).

Results: After 9.7 years follow-up 7 patients would undergo the operation again and were satisfied with the results. At latest follow-up the median DASH score was 37,3 (range 8,3-61,7), the median SIP-68 score was 6,5 (range 0-43) and the median HADS score was 3,0 (range 0-14) for anxiety and 3,0 (range 1-19) for depression. In the EQ-5D-5L patients had most difficulties in self-care, usual activities and pain/discomfort. The median overall health status was 69 (range 20-95).

Conclusion: A mid-humeral amputation has a place in the rehabilitation for traumatic complete brachial plexus lesion with satisfying long-term results. However, setting the right indication is essential.

"Fishtail deformity" and secondary osteochondral lesion of the elbow as a late onset complication after juvenile distal humeral fracture, a case report (9853)

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"Fishtail deformity" is a rare complication seen in patients who suffered a distal humeral fracture in the early childhood after conservative or surgical fracture treatment. There are only few case reports in the literature on this subject. Based on a case of a 9-year-old patient, who presented himself to our clinic with a dislocated osteochondral lesion "fishtail deformity" and a history of surgical treated transcondylar fracture at the age of four, we want to draw attention to this rare complication and give an overview of the current literature.

Using a case report and a review of the literature, we give an overview on pathogenesis, clinical presentation and treatment options.

We present one case of a young patient who sustained a distal humeral fracture at the age of four. It was treated with closed reduction and K-wire fixation. The patient showed an uneventful course without impairment and full range of motion in the follow-up after K-wire removal. 5 years later, he suffered a slight distortion of the elbow followed by pain, impaired range of motion and a sensation of joint blockage. The imaging showed dislocation of an osteochondral lesion and "fishtail deformity" of the distal humerus. We performed open partial refixation, bone grafting and minced autologous chondral AMIC procedure to address the osteochondral lesion.

"Fishtail deformity" is a rare growing disorder in children with a history of a distal humeral fracture. Patients can complain about pain and impaired range of motion of the elbow up to many years after the first trauma. Some present with osteochondral lesions. It can occur both after non-operative and operative treatment of a distal humeral fracture. It is probably caused by an arrest of the ossification or impaired vascularisation between the humeral capitulum and the humeral trochlea. An observational treatment is recommended if the range of motion is just slightly impaired. An operative treatment should be considered in patients with highly impaired range of motion, pain or joint blockage. Radiological long-term follow-up after distal humeral fractures could be discussed, even in asymptomatic patients, to avoid delayed diagnosis and complications.

Biomechanical analysis of arthroscopic single anchor repair techniques of upper third subscapularis tears (9866)

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Introduction: Upper third tears of the subscapularis tendon can be repaired successfully with a single anchor according to previous literature. The aim of the present study was to compare three single anchor repair techniques regarding fixation strength, footprint coverage and contact pressure in a biomechanical test set-up on human cadaveric shoulders.

Methods: Eighteen human cadaveric shoulders were randomized in three groups with respect to the repair technique; group 1: knotted lasso-loop mattress, group 2: knotted mattress and group 3: knotless tape repair. Upper third tears of the subscapularis tendon (Lafosse type 2) were created and repairs were performed with additional contact pressure and area measurement using a pressure mapping system. Cyclic testing was performed by loading the subscapularis from 10 to 100 N for 300 cycles. A position-controlled ramp protocol up to 30 N and 50 N was used to allow for pressure measurements. Finally, specimens were loaded to failure and failure modes were recorded.

Results: The three groups were not significantly different regarding age, gender, bone mineral density at the lesser tuberosity, subscapularis footprint size and defect area created at the upper subscapularis insertion. A significant difference was detected between group 1 (48.6 ±13.8%) and group 2 (25.9 ±5.7%) regarding pressurized footprint coverage ($p = 0.028$).

Ultimate load to failure was 630.8 ±145.3 N in group 1, 586.9 ±220.7 N in group 2 and 678.2 ±236.5 N in group 3, respectively. Cyclic displacement was similar in all three groups with an average displacement of 1.2 ±0.6 mm. The highest stiffness was found in group 1 with 88 ±30.3,

which was not statistically significantly different to group 2 (65 ±27 N/mm) and group 3 (83.9 ±32.9 N/mm).

The most common mode of failure was suture cut-through at the suture-tendon interface (44%). Failures in group 3 were less commonly associated with suture cut-through (33% vs. 50% in group 1 and 2), but no significant differences were found.

Conclusion: All three tested single anchor repair techniques of upper third subscapularis tears were able to provide sufficient biomechanical stability. Knotted lasso-loop mattress and knotless tape repair were superior regarding pressurized footprint coverage compared to a knotted horizontal mattress technique.

Radius shaft fracture combined with a dislocation of the radial head – A rare pattern of injury (9879)

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Introduction: Combinations of forearm fractures and dislocations of adjacent joints are well described in the literature, i.e. Monteggia fracture, Galeazzi fracture or Essex-Lopresti lesion. We present a case with a combination of a radial diaphyseal fracture with a ventral dislocation of the radial head.

Case Presentation: A male patient (28y) presents after a bicycle accident with a fall onto the outstretched left arm. Preoperative X-rays showed a radial fracture at the middle of the diaphysis. There was also suspicion of possible dislocation in the distal radioulnar joint. After open reduction and internal fixation (ORIF) of the radius shaft fracture, the distal radioulnar joint appeared to be reduced and stable. Surprisingly the postoperative X-ray revealed an anterior dislocation of the radial head. On day 2 postoperatively, an attempt of closed reduction of the radial head luxation failed. Revision surgery with open reduction, suture of the annular ligament and refixation of the capsular ligamentous complex to the lateral epicondyle with a suture anchor, was performed. Postoperative X-rays showed a correct articulation of the joint. For 6 weeks the patient performed non-weight-bearing mobilization in an elbow motion orthosis, followed by increased strengthening. Three months postoperatively, the patient was nearly asymptomatic with regular radiologic follow up, slightly limited range of motion (flexion/extension 120/5/0°; pro/supination 70/0/50°) and stable joint.

Discussion: On closer inspection of the radiograph: An osseous fragment in the region of the interosseous membrane (IOM) can be seen, indicating a possible osseous avulsion. Hence, we assume the presence of an unidentified concomitant lesion of the interosseous membrane and rupture of the annular ligament without sub-/luxation in the elbow. To our best knowledge, this is the first published case, describing the combination of these injuries. However, in biomechanical studies the function of the interosseous membrane as important stabilizer of the radial head is described.

Conclusion: The combination of a radius shaft fracture and a dislocation of the radial head is very rare and to our best knowledge, not yet described in the literature. If a lesion of the IOM is present, an instability of the radial head should be excluded. In this situation, we recommend a careful intraoperative clinical and radiologic evaluation of the stability of the radial head.

Treatment of medial clavicle epiphyseolysis associated with medial clavicle fracture: a case report (9899)

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Introduction: Fractures of the medial third of the clavicle are rare (only 2-4% of clavicle fractures). This type of fractures is due to high-energy trauma associated with multiple organic injuries and a high mortality rate. In case of posterior dislocation of the clavicle, serious complications can occur: compression/injury of vascular and nerve structures, trachea, esophagus, and pneumothorax. In young patients, epiphyseolysis is more common than fracture. The physis in fact does not close until the age of 20-25 years. In case of posterior dislocation or relevant instability,

the treatment of the lesion can be surgical. We present here a case report of a rare case of simultaneous epiphysiolysis and medial fracture of the clavicle, treated surgically.

Methods: A 17-year-old patient fell from his bicycle onto his right shoulder, complaining of pain not only in the shoulder but also in the sternal area. He had no skin lesion, dysphagia, dyspnea, or sensory-motor deficits, and vital signs were normal. Imaging (standard RX and angio-CT) demonstrated a posteriorly displaced medial clavicle fracture with a dislocation of the sternal clavicle joint, with compression of residual thymic tissue. We proposed open reduction and internal fixation of the fracture to the patient. Under general anesthesia was inducted in dorsal decubitus. A transverse incision centered on the fracture was made. After the fragment was released and anatomic reduction was achieved, a grind locking plate (1.0 mm) was attached. Intraoperative imaging after fixation, the clavicle remained elevated with respect to the contralateral, due to epiphysiolysis found after further exploration of the intact periosteum. We reduced the epiphysiolysis by reducing the clavicle in its periosteal sleeve and fixed with transosseous sutures. The periosteum was closed to cover the plate.

Results: The clavicles are symmetrical, and the patient has resumed a complete and symmetrical mobilization without pain. The Oxford Shoulder Score at 5 months post-operative was 12/60. The radiological result was satisfactory without signs of displacement.

Conclusions: Medial clavicle fracture-dislocations are rare but potentially serious injuries. Posterior dislocation always requires surgical intervention. In our particular case, surgical treatment allowed us to diagnose epiphysiolysis. Even in case of a confirmed fracture, the suspicion of a lesion of the physis plate must be considered, to avoid malunion.

Surgical technique for radial head fractures with more than 3 fragments: A new concept of fixation (9905)

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INTRODUCTION: The treatment of comminuted radial head fractures (RHF) type III/IV of the Mason Johnston's classification still remains controversial. According to the current literature, RHF with more than three parts are not suitable for repair. Therefore, most authors suggest a primary radial head arthroplasty (RHA). Nonetheless, in case of unstable elbow injuries, the management of multifragmentary RHF with radial head replacement seems to have 25% risk of reoperation due to stiffness and painful loosening. Under this scenario, given the improvement of reduction and fixation technique we enlarged the indication of osteosynthesis before RHA. The purpose of this retrospective study is to determine the functional results in terms of the Broberg and Morrey score and radiological failure rate following open reduction and internal fixation (ORIF) with headless compression screws and/or 1.0-2.8 plates of RHF with more than three articular fragments.

METHODS: A retrospective single-center case series. Between 2012 and 2019, patients who had undergone ORIF of RHF with more than three articular fragments were included. We standardized some critical steps of the surgery in all our cases: we used a ventralized approach using extensor split, respected the annular ligament, and used low profile implants (headless screws, plates with a thickness of 1.3mm). Nine patients, with an average age of 52 years had a clinical and/or radiological average follow-up of 47 months.

RESULTS: The preoperative radiographs and CT scans identified 8 fractures with 4 fragments and 1 with 5 fragments. Four fractures were classified as Mason III and 5 as Mason IV. Four patients underwent osteosynthesis with plate and screws while 5 patients with screws only. For the 8 patients who retained the radial head, the mean Broberg and Morrey score was 94 points (range, 75 to 100 points) the result was rated as excellent in five patients, good in two and fair in one at the final follow-up. Overall, seven of the nine patients (77%) had satisfactory results. Postoperatively, one patient of nine (11%) showed a fixation device failure after 6 weeks and sustained a RHA. All other patients showed radiological healing of the fracture with an average of 3 months.

CONCLUSION: According to our results, there are many occasions, where ORIF can be successfully applied in case of RHF with more than 3 fragments.

Risk Factors for Dislocation after Reverse Total Shoulder Arthroplasty: A Systematic Review and Meta-Analysis (10008)

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Instability after reverse total shoulder arthroplasty (RTSA) is a dreaded complication. Risk factors for developing postoperative instability are uncertain. The aim of this systematic review was to quantitatively and qualitatively analyze the risk factors of instability after RTSA. Of 1183 studies identified, twelve studies involving 3810 patients were included. The mean age was 68.8, and the mean follow-up was 46 months. The pooled rate of dislocation after RTSA is 4.0%. Several patient-specific and implant-specific risk factors have been identified and especially implant-specific risk factors appear avoidable with the current knowledge, implant design and technology.

Level of evidence: Systematic review of minimum level IV studies

Keywords: Reverse total shoulder arthroplasty, complication, dislocation, instability, systematic review

Conversion to Reverse Total Shoulder Arthroplasty With and without Humeral Stem Retention: Mid-to Long-Term Results (10010)

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Background: Over the past decade, conversion to reverse total shoulder arthroplasty (RTSA) has become the preferred treatment for revision of an anatomic hemi (HA) or total shoulder arthroplasty (TSA). However, conversion of failed stemmed shoulder arthroplasty to RTSA is still a highly demanding procedure and carries unique technical challenges and risks.

Questions/purposes: This study aimed to analyze the mid- to long-term results after conversion of failed anatomical shoulder arthroplasty to RTSA and investigate whether preserving the humeral stem offers advantages over revising the humeral stem.

Materials and methods: Between 2005 and 2018, 99 hemiarthroplasties and 62 total shoulder arthroplasties (total = 161 shoulders; 157 patients) were revised to RTSA without (n = 47) or with (n = 114) stem exchange. Complications and revisions were documented from medical and surgical records. Longitudinal pre- and postoperative clinical (Constant-Murley (CS) score, Subjective Shoulder Value (SSV)), and radiographic outcomes were assessed. Complete clinical and radiographic follow-up was available on 80% of shoulders (127 patients; 128 of 161 procedures, 46 without and 82 with stem exchange) at a minimum of 24 months and a mean of 70 months (range, 24–184 months).

Results: Humeral stem retention was associated with a significantly reduced surgical time (193 minutes vs 227 minutes, p=0.001, less blood loss (591 mL vs 753 mL, p=0.037), less intraoperative complications (13% versus 19%; odds ratio (OR), 1.4, p=0.32) and fewer subsequent reinterventions (19% versus 28%; OR, 2.3, p=0.06). The complication/revision rate leading to drop out from the study was considerable in the stem revision group (ten patients; ten of 114 shoulders (9%)), but there were no complication-related dropouts in the stem-retaining group.

Conclusion: Our findings suggest that humeral stem revision is associated with decreased surgical time, less blood loss, less intra- and postoperative complications, and a lower revision rate compared to humeral stem retention. Based on these findings, a shoulder arthroplasty system modularity offers substantial benefit if conversion to reverse total shoulder arthroplasty becomes necessary.

Level of evidence: Level III, therapeutic study.

Keywords: Reverse total shoulder arthroplasty, Revision shoulder arthroplasty, Failed shoulder arthroplasty, Hemiarthroplasty, Anatomic total shoulder arthroplasty, Conversion

A Report of Three Cases of Intra-Articular Corrective Osteotomies for Distal Humerus Malunion (10022)

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Background: The incidence of distal intra-articular fractures of the humerus is 2% in the adult population and even less in the pediatric population. Especially in pediatric population the misdiagnosis of intra-articular lesions is frequent and conservative treatment may evolve into malunion.

If left untreated, the natural history is characterized by early arthrosis. Posttraumatic intra-articular malunion of the distal humerus represents a major challenge when considering its surgical reconstruction. Few cases are described in the literature.

Methods: We included 3 consecutive patients, treated with corrective osteotomy for distal articular humerus malunion. The patients underwent the surgical reconstruction at 9, 15 and respectively 37 months after the initial trauma. The age at the time of the osteotomy was 26, 13 and 16 years old. The patients were followed postoperatively for 31 and 28 months, latest case being operated 2 weeks before the study began. The initial injuries were treated conservatively in all patients. The average preoperative arc motion was 102, 125 and 120 degrees.

Results: Due to the fact that the third patient was operated short before the study started, we'll present the clinical outcomes of the first two patients. The clinical and radiological outcomes were satisfactory with a postoperative arc of elbow motion of 150 and 135 degrees. The patients could return to all their daily and sport activities without any limitations. No osteoarthritic changes were seen on the postoperative x-rays. One patient presented a delayed wound healing after the initial intervention probably due to the tension at the surgical site. Later on, the same patient underwent a partial implant removal and cubital nerve release due to the discomfort.

Conclusion: This case emphasizes the importance of adequate initial management of intra-articular distal humerus fractures. Surgical reconstruction of a malunited distal humerus fracture is technically challenging, but can improve function and relieve pain in the young active adult by restoring intrinsic anatomy of the elbow.

Risk factors and intraoperative complications during revision of shoulder prostheses (10028)

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Background: The increase in the number of first-line shoulder arthroplasties has led in recent years to an increase in the number of shoulder replacement procedures. Revision surgery is technically more difficult, with often more consequent complications. Few data are published on the occurrence and risk factors of these complications.

Objective: The objective is to evaluate 1) the prevalence of intraoperative humeral fractures (FHP) during prosthetic shoulder revision and 2) to identify these risk factors.

Materials and Methods: Between 2008 and 2020; 89 patients having undergone shoulder prosthesis revision were included in a monocentric retrospective study. In all of these patients, the glenoid and/or humeral implant had been changed. Five groups of patients were enrolled:

1. fracture prevalence in the study population (10/89)
2. fracture occurrence by age (more than 70 years=3 and less than 70 years=7)
3. fracture occurrence by infection (7 patients)
4. fracture occurrence by stem length (10 long and 0 short stems)
5. fracture occurrence by cement (6 cemented and 4 uncemented stems).

Results: Out of 89 patients with an average mean age of 69.5 years (28-99), 10 fractures (11.2%) occurred at revision. All fractures (100%) occurred during stem extraction (long (n=10), short (n=0), cemented (n=6) or uncemented (n=4)). The risk of intraoperative fracture was associated with long primitive stem ($p=0.0001$) and statistically insignificant at advanced age ($p=0.41$); infection of the primitive prosthesis ($p=0.07$); female sex ($p=0.58$) and cemented primitive stem ($p=0.378$).

Conclusions: Humeral fracture is a frequent phenomenon during shoulder prosthesis revision. The main favoring factor was mainly the length of the primitive stem.

A02 – HAND

Impact of operations under WALANT type anaesthesia on the operating time for carpal tunnel and spring finger surgery by doctors in training (9787)

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Introduction: Wide Awake Local Anaesthesia No Tourniquet (WALANT) is a commonly used operating technique in hand surgery. Adrenaline mixed with the locally injected anaesthetics limits bleeding during the procedure, but does not completely eliminate it, as a tourniquet would do with endovenous anaesthesia (EVA).

The aim of this study is to evaluate the operating time for carpal tunnel and spring finger releases of assistant physicians in training for the title of specialist in orthopaedic surgery and traumatology, under the supervision of a hand surgeon. Our hypothesis being that the operating times are slightly longer with a WALANT anaesthesia technique compared to an endovenous anaesthesia (EVA) technique but that the rate of early complications is similar.

Method: This is a retrospective study comparing patients operated on by assistant physicians, in training for the title of specialist in orthopaedic and trauma surgery, with isolated carpal tunnel release or isolated spring

finger release under endovenous anaesthesia, performed by an anaesthesiologist, and under WALANT, performed by the surgical team. Operations involving other simultaneous procedures were excluded. The operating time was measured from incision to closure. Patients were followed up at 2, 6 and 12 weeks post-operatively and the following complications were investigated: wound dehiscence, infection, neurological lesion and incomplete neurolysis (persistence of symptoms).

Results: Between January 2017 and January 2021, 34 carpal tunnel releases (18 under EVA and 16 under WALANT) and 44 spring finger releases (24 under EVA and 20 under WALANT) were completed. The mean operating time for carpal tunnel release was 14.6 and 20.1 minutes, under EVA and WALANT, respectively (p-value <0.05). The mean operative time for spring finger release was 16.0 and 15.8 minutes under EVA and WALANT, respectively (p-value 0.49). There were no complications in either group.

Conclusions and perspectives: The WALANT makes it possible to continue to teach assistant physicians in training for the title of specialist in orthopaedic surgery and traumatology, in hand surgery. Compared to endovenous anaesthesia, the operating time is increased by about 25% for carpal tunnel release but unchanged for spring finger, while not increasing the complication rate.

A03 – SPINE

The 16-item version of the SRS-instrument shows better structural validity than the 20-item version in young patients with spinal deformity (9984)

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Introduction: Previously, in patients with adult spinal deformity, 16 of the non-management items of the SRS-instrument showed a significantly better fit to the theoretical four-factor model (pain, function, self-image, mental health) than did all 20 items. The worst-fitting item per domain was recommended for exclusion (Q17, sick days; Q15, financial difficulties; Q14 personal relationships; Q3, nervous, respectively). Whether the same phenomenon is observed in data from younger (<20y) patients, for whom the questionnaire was originally designed, is not currently known.

Methods: This was a cross-sectional evaluation of the SRS-instrument's factor structure and its equivalence across different language versions in young (<20y) deformity patients. Confirmatory factor analysis was performed on the 20 non-management items of the questionnaire completed by 3440 adolescents with spinal deformity (2746 English-speaking, 206 Spanish, 223 Italian, and 265 German; 70% female; mean age, 14.9 ± 2.2 y), to compare the relative fit of the data to a 20-item single-factor structure, a 20-item 4-factor structure, and a 16-item 4-factor structure. Item loading and the goodness of fit were determined from the root mean square error of approximation (RMSEA) and the comparative fit index (CFI). Equivalence of item-loading was compared across languages.

Results: Compared with the 20-item version, the 16-item solution significantly increased the fit ($p < 0.001$) across all language versions, to achieve good model fit (CFI=0.96, RMSE=0.06; Figure 1). For both 16-item and 20-item models, equivalence across languages was not reached, with some items showing weaker item-loading for some languages, in particular the German-language version.

Conclusion: Also in patients with adolescent idiopathic scoliosis, the shorter version of the SRS-instrument shows a better fit to the intended 4-factor structure. The wording of some of the items, and/or their equivalence across language versions, may need to be addressed. Questionnaire completion can be a burden for patients; if a shorter, more structurally valid version is available, its use should be encouraged. This shorter version of the SRS-instrument, with removal of ill-fitting items, should deliver more meaningful information on patient-reported outcomes and may also serve to improve compliance with questionnaire completion.

An Atypical Complication of Anterior Cervical Discectomy and Fusion: Sulcal Artery Syndrome (10007)

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Introduction: Anterior cervical discectomy and fusion (ACDF) is a frequent intervention in spine surgery. Neurologic worsening, vocal cord paralysis and Horner syndrome are among the known complications. Here we describe the first case of a sulcal artery syndrome after such an intervention.

Methods: We report the case of a 47-year-old woman who underwent ACDF with plating from C3 to C5 for degenerative cervical disc disease. Intraoperatively, while the C4/C5 cage was positioned, a sudden loss of MEPs on the right side was noted while SSEPs stayed unaltered. Thorough inspection did not show any neural compression or vascular damage. After an uneventful immediate postoperative course, the patient developed a progressive anesthesia on the right side with a sensory level at Th3, associated with impaired hot/cold discrimination about 7h

after the surgery. On the left side, a slight hemiparesis with strength M4/5 was noted. Two days later, the symptoms worsened with stinging sensations and hypoesthesia in the territory of the right maxillary nerve.

Results: A CT-scan showed no displacement of the material and no hematoma. The MRI of the brain and cervical spine showed a spinal cord ischemia at the level of C3-C4, in the territory of the sulcal artery. Oral steroids and acetylsalicylic acid were started. After worsening of the symptoms, a second MRI showed a progression of the edema, potentially involving the caudal part of the spinal nucleus of the trigeminal nerve. At one year after the intervention there is residual impairment of hot/cold discrimination and position sense in the right side of the body.

Conclusion: We report the first case to our knowledge of sulcal artery syndrome after ACDF with the clinical correlate of an incomplete Brown-Séquard syndrome. No evidence of direct damage to the spinal cord was found. The probable cause is vessel occlusion, but the exact mechanism cannot be ascertained. In these circumstances, even though the prognosis is mostly favorable, further work-up in search of possible vascular pathology (arteriosclerosis, dissection) and/or hypercoagulable states may be warranted.

Paraspinal intramuscular Schwannoma arising from posterior dorsal ramus of D1 (10009)

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BACKGROUND: A pure intramuscular paraspinal schwannoma is an extremely rare condition, with only few case reports in the literature. Due to low frequency and lack of specific clinical signs and symptoms, pre-surgical diagnosis is difficult. Only at the pathological analysis the lesion is usually clearly identified. We report here a case in which pre-surgical imaging was highly suggestive for a diagnosis of paraspinal Schwannoma.

CASE PRESENTATION: A 69-year-old female patient present unspecific right paravertebral numbness, associated with a swelling homogeneous subcutaneous mass, right-sided, without skin reaction. No neurological signs or pain were assessed. At levels D3-D5, the MRI showed a 5x2x1 cm right-sided intramuscular paravertebral isolated mass, with circumscribed margins and heterogeneous component, partly cystic. No surrounding edema was found. At the upper pole of the lesion, it was possible to identify a paraspinal nerve coming down from D1, from which the mass arises. According to clinical and radiological findings, first hypothesis was a paraspinal schwannoma arising from a right dorsal ramus of D1. An elective surgery was performed. Histopathology confirmed a rare OMS I "ancient schwannoma". The lesion was encapsulated inside a perineural sheet, with no residual tumor at the upper and lower extremity, confirming a complete resection. A clinical and radiological follow up was performed at 6 weeks postop, 6 and 12 months, with no evidence of tumor recurrence.

DISCUSSION: As underlined, a paraspinal intramuscular schwannoma is very rare, especially because rarely symptomatic. Besides, it is often impossible to give a clear pre-operative suspicion of these lesion, which are usually misdiagnosed in favor of more common back masses like lipomas or hemangiomas. It is mandatory to check specifically, at MRI and intraoperatively, for an eventual hypertrophied nerve ramus from which the schwannoma could arise, in order to perform a complete resection: although benign on 99% of cases, schwannomas present 1% of malignant degeneration into neurofibrosarcoma.

CONCLUSION: A schwannoma, although rare, should always be considered in the differential diagnosis when a patient with paraspinal mass lesion comes at our attention and a specific investigation with contrast enhanced-MRI is required before surgery. A complete "en bloc" resection with nerve identification is recommended, according to the rare but still possible malignant degeneration of a schwannoma.

A04 – HIP

Angiosarcoma can be mistaken for metal-on-metal related pseudotumor (9586)David Windischbauer¹; Sonja Cronenberg¹; Martin Clauss²; Christoph Schwaller¹¹ Kantonsspital Olten; ² Universitätsspital Basel (USB)

Although a pseudotumor is a known complication of metal-on-metal (MoM) total hip arthroplasty (THA), a malignant process should be ruled out before surgical intervention.

We present a case of a 62-year-old patient, who was believed to have a MoM related pseudotumor for years turning out to be an angiosarcoma.

After primary implantation, the patient presented 16 years later with a cup loosening, which was diagnosed by performing a SPECT CT. Prior to revision surgery in January 2017, we performed a CT scan of the hip, which showed a new solid mass, likely a MoM related pseudotumor, reaching from the left hip into the pelvis.

In 02/2019, a prosthesis joint infection (PJI) was suspected, due to new pain in the upper leg and a suspect SPECT-CT scan and a joint sample showing Staph. Epidermidis. A revision surgery was performed with no confirmation of an infection.

In 08/2019 the patient presented with recurrent posterior dislocation and requiring inlay change. 3 weeks later the patient was readmitted with massive exudation of the wound and a hemoglobin of 45 g/L. The performed CT scan showed only the known mass believed to be a MoM Pseudotumor. The patient was treated as a PJI with debridement and implant retention, no active bleeding was found intraoperatively. After continuing secretion, even with negative pressure wound dressing another revision was necessary.

Prior to surgery CT-Angio was obtained, showing again no active bleeding. Our hematologists could not find a disorder explaining the bleeding. After the second revision, the bleeding continued, and with an active blood loss of unknown origin, the patient was referred to the University hospital of Basel (USB).

After several further revisions without stopping the bleeding the pseudotumor was suspected to be the origin of the blood-loss, the mass was excised en bloc as R2 resection showing an angiosarcoma. Post R2 resection there were no further surgical options. Palliative radiotherapy was performed, stopping the bleeding.

It is discussed that long-existing MoM pseudotumors can transform into a malignant process. Angiosarcoma are rare with >1% of all soft tissue sarcoma. Survival rates post diagnosis range from 6-16months.

After this case, we recommend to confirm the diagnosis of a pseudotumor with MARS-MRI and histological analysis of every unknown mass resected in joint replacement surgery.

as well as the trochanteric fracture consolidated. However, cortical thickening developed around the tip of the stem along with proximal stress shielding. With the hypothesis of a load transfer in the anchoring area of the stem exceeding resistance of the cortical bone, subcutaneous teriparatide therapy was started for 24 months.

Results: 6 months later the patient was already completely pain free and ambulating without discomfort. Conventional radiographs showed increased bone density in her femur. Within months after discontinuation of teriparatide, the symptoms gradually reappeared. Scintigraphy confirmed relapse of pathological activity at the tip of the stem. The treatment was subsequently changed to denosumab, with moderate improvement of the pain.

Conclusion: Stem tip pain is a well known complication of distally engaging hip implants. Various surgical options have been suggested over the years to address this condition if conservative treatment fails. Pharmacological treatment has never been tested. Teriparatide is one of the rare truly osteogenic substances available. Its use is restricted to 24 months because of induction of neoplasia. This successful off-label use has not been described so far and might be of interest for the future treatment of this biomechanical complication.

First case of bilateral, simultaneous, acute on chronic, unstable slipped capital femoral epiphysis (SCFE) treated with modified Dunn procedure (9827)Corinne Andrea Zurmühle¹; Francesca Lucadei²; Ines Raabe²; Matthieu Hanauer²; Dominic Behrends²; Moritz Tannast¹¹ Universität Fribourg, HFR hôpital cantonal Fribourg; ² HFR -Hopital Cantonal Fribourgeois

Introduction: Bilaterality of slipped capital femoral epiphysis is reported in 18 – 50% in literature, whereby sequential occurrence is more often seen than simultaneous SCFE. Almost 50 – 60% of children with bilateral SCFE presents a simultaneous involvement but they are often stable.

In literature as well as in our database we could not find any case which should a bilateral, simultaneous, acute on chronic, unstable slipped capital femoral epiphysis.

We would like to present such a case which we recently treated.

Methods: A 15 years old adolescent, African origin, addressed by the family doctor, with bilateral inguinal hip pain since 2 – 3 months showed an acute pain exacerbation after weeks of physiotherapy without pain relief. The clinical examination showed a painful, bilateral reduced flexion, internal/external rotation of 70-0-0°, limited abduction. Radiological assessment presents a bilateral severe slipped capital femoral epiphysis. Based on that we performed a bilateral modified Dunn procedure. The more severe SCFE was operated as first case. The contralateral side was temporary fixed with a k-wire and was definitively treated at the fifth postoperative day.

Results: Intraoperatively the typical antero-superior chondrolabral lesions could be seen. The hips showed a hinged abduction. The epiphysis was in both hips unstable. Callus formation of the metaphysis was visible and reduced during modified Dunn procedure to reduced tension of the vessels. On both sides the epiphysis was vascularized before and after reduction and showed bleeding after we performed a drill holes at the level of the epiphysis. Intraoperatively an impingement free range could be obtained.

Conclusion: This patient is the first case in which we see a bilateral, simultaneous, unstable, slipped capital femoral epiphysis treated with the modified Dunn procedure. Long-term follow-ups and evaluations will be interesting to evaluate avascular necrosis, quality of life and clinical function of the hip joints.

Successful osteoanabolic treatment with Teriparatide for symptomatic stress concentration at the tip of a tapered, fluted, uncemented hip arthroplasty stem: A case report (9761)

Ruben A. Mazzucchelli; Christoph Meier; Peter Wahl

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Introduction: Since cementless stems have been introduced for total hip arthroplasty (THA) thigh pain can be a relevant issue. Its main cause is believed to be a mismatch in stiffness between the implant material and the bone leading to pathological stress transfer, but it can also depend on implant design, sizing, surgical technique, component malpositioning and patient anatomy as well as bone mineral density.

Methods: A 79-year-old female patient with severe osteoporosis, already treated with bisphosphonates, sustained an intertrochanteric fracture of the left femur after a fall. Due to fracture comminution, osteoporosis and concomitant advanced osteoarthritis of the hip joint, THA was preferred over internal fixation. The patient therefore underwent THA over a transfemoral approach with an uncemented, curved, modular, tapered, fluted, titanium-alloy stem. Postoperatively, the patient showed good improvement of hip function but started to develop exertional thigh pain 6 months after surgery. Radiologic follow-up studies showed a correct position of the implant, without any subsidence, and the osteotomy

CORRECTION OF COMPLEX THREE-DIMENSIONAL DEFORMITIES AT THE PROXIMAL FEMUR USING INDIRECT REDUCTION WITH ANGLE BLADE PLATE AND PATIENT-SPECIFIC INSTRUMENTS (9851)

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Introduction: Corrective osteotomies in complex proximal femoral deformities can be challenging wherefore subsidies in preoperative planning and during surgical procedures are considered helpful. Three-dimensional (3D) planning and patient-specific instruments (PSI) are already established in different orthopedic procedures. This study gives an overview on this technique at the proximal femur and proposes a new indirect reduction technique using an angle blade plate.

Methods: Using computed tomography (CT) data, 3D models are generated serving for the preoperative 3D planning. Different guides are used for registration of the planning to the intraoperative situation and to perform the desired osteotomies with the following reduction task. A new valuable tool to perform the correction is the use of a combined osteotomy and implant-positioning guide, with indirect deformity reduction over an angle blade plate.

Results: An overview on the advantages of 3D planning and the use of PSI in complex corrective osteotomies at the proximal femur is provided. Furthermore a new technique with indirect deformity reduction over an angle blade plate is introduced.

Conclusion: The understanding of complex deformities at the proximal femur is enhanced by the use of preoperative 3D planning and the additional PSI allow an accurate intraoperative execution. Further advancements in this technique, such as indirect deformity reduction over an angle plate, allow complex corrections with fewer surgical steps and less harm to the surrounding soft tissue.

Massive metallosis in ceramic-on-metal bearing (9896)

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Introduction: Ceramic-on-metal (CoM) bearings show significantly lower particle wear compared to metal-on-metal (MoM) in laboratory settings. FDA approved CoM bearings in 2011. More recent in vivo studies found serum ion levels (Co and Cr) lower in CoM compared to MoM bearings three years after implantation, but an increase after 5 years. The reason for increased wear rates remains debated. Nevertheless, only few case reports exist describing implant loosening due to metallosis for CoM bearings.

Case report: We present the case of a 50 year old female patient who after 18 previous surgeries due to bilateral high hip dislocations received a total hip prosthesis in 2010 with a ceramic-on-metal bearing. For the past 2 years she suffered of constant hip pain and was only able to ambulate with crutches. Radiographs showed an eccentric position of the head in the cup with position of implants in a normal range. Revision surgery was performed using a stepped trochanteric flip osteotomy as approach. Intraoperatively black liquid filled the joint and massive metallosis stained bone and surrounding tissue. The anterior bony half of the acetabulum was missing, leaving half of the metal back hanging free with the psoas tendon rubbing over the metal. After removal of all implants, a thorough debridement was performed. The acetabular defect was reconstructed with a shell formed from a femoral allograft head held in place with an acetabular reinforcement ring with hook. The new bearing is ceramic-on-polyethylene, the stem uncemented.

One year postoperatively the patient has little to no pain and is able to ambulate without assistive devices for short distances.

Discussion: Eccentric wear of the liner as well as metallic marks on the ceramic head were visible after removal. We therefore hypothesize that despite acceptable position of the implants edge loading was the main cause for the metallic wear. The age of the bearing may be of less importance.

Conclusion: CoM bearings are still FDA approved to this day, but have never been widely used in Switzerland. Due to the negative experience with this case without a clear cause being identifiable, we recommend monitoring of all these patients especially as recent findings show a possible increase in serum ion levels (chromium) after five years. Therefore, regular controls of serum ion levels and in case of elevated values or clinical symptoms MRI imaging to rule out pseudotumor formation seems mandatory to us.

Anaemic arterial bleeding due to secondary displaced lesser trochanter after CRIF of an intertrochanteric fracture (9940)

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Orthopädie Sonnenhof

Introduction: Intramedullary nailing (IM) of proximal femoral fractures (PFF) is among the most common surgical procedures that are performed on geriatric traumatology patients. Vascular injuries can be caused by the accident itself, iatrogenic or, as in our case, by secondary displaced bony fragments. When it affects the profunda femoris artery (PFA), this vascular injury can be potentially life-threatening.

Material and Methods: We report the case of a 95-year-old patient who sustained a non-displaced intertrochanteric femoral fracture after a fall without any other injuries. Surgery was performed the following day with closed reduction and internal fixation (CRIF) using a trochanteric nailing system (TFNA®). The procedure was uneventful, and the patient was allowed to full weight bearing postoperatively. On day two after surgery the hemoglobin level dropped, and postoperative radiographs showed a secondary displaced lesser trochanter fragment. A CT-angiography revealed active bleeding from a perforated branch of the PFA caused by the secondary displaced lesser trochanter. The affected branch was urgently coiled by an interventional radiologist.

Results: A total of five red blood cell counts were transfused. The patient was discharged 13 days after initial surgery. At 6 weeks follow-up appointment the patient was in a good health condition and pain free while full weight-bearing.

Conclusion: PFF are common with approximately 100.000 cases in Germany in 2018. Inpatient mortality rate is 2.9 % raising to 15.1% after 90 days and up to 37% after one year. Preferred treatment is CRIF. Most commonly used implants are sliding hip screws or intramedullary nails. The incidence of vascular injuries is 0.5%, mostly due to iatrogenic lesions related to the surgical procedures. While venous bleedings of the perforating veins require open surgical revision, lesion of the PFA can be treated with percutaneous embolization.

Ongoing decrease of hemoglobin levels after surgery, distinct swelling of the thigh and increasing pain are indicators for persistent bleeding. Secondary dislocation of the lesser trochanter with injury of the PFA is a rare but potentially life-threatening complication after PFF. The combination of dislocated lesser trochanter fragments and persistent blood loss should make the treating physician think of this rare complication. Exact localization of the source of bleeding with CT-angiography is crucial to determine the appropriate treatment.

A05 – KNEE

Chylous Joint Effusion of the Knee – A case report and literature review (9679)Franz Tillmann¹; Flavio Cagienard; Ralph Melzer; Judith Bering¹ Luzerner Kantonsspital Luzern

Introduction: Chylous or milky joint effusions are extremely rare. Here we describe a patient with accelerated ipsilateral anterior knee pain after implanting a total hip prosthesis and chylous effusion in the knee joint.

Case: A 54 y/o female patient suffered knee pain three months after an ipsilateral hip prosthesis was implanted. The patient denied any trauma of the knee, while she detected a painful swelling of the knee directly on the first day after surgery. Initially the swelling was assumed as a postoperative suffluent hematoma and treated with oral analgetics. A week before the patient was seen in the orthopedic follow up, her knee was punctured by the general practitioner, showing "milky fluid". No fever or shivering. The examination revealed a tender knee with a large effusion, no erythema/warmening. The knee motion was decreased with ext./flex. 0/0/100°. The knee was punctured again in our clinic showing white, milky fluid. The laboratory investigation revealed massive lipids without inflammation or crystals and we made the diagnosis of a chylarthros. After exclusion of a lymphfistula the patient underwent conservative treatment. Eight months after first symptoms the patient was symptom-free without any deficits. The cause of the chylous effusion couldn't be determined.

Discussion/Conclusion: Increased lipid content of joint fluid, presenting as a macroscopically milky fluid is equivalent to a very rare chylous effusion 1,2. These cases are reported with a traumatic joint injury involving the lymphatic system, or in patients, who suffer a systemic lupus erythematosus, RA, filariasis or pancreatitis with fat necrosis^{5,6,7,8}. The largest series was described by Das and Sen⁴, who screened 25 patients with filariasis who suffered acute knee pain with inflammation but sterile effusion, all self limited. Synovial biopsies in these patients showed inflammatory changes and the lymphangiogram (n=5 patients) showed periarticular lymphangiectasia, varicosities of the popliteal system with a blind channel, ending in the knee joint which suggests a lymphfistula. Diagnostic fluid aspiration and its laboratory investigation (oil staining) is mandatory to make the diagnosis (lipid concentration >800 mg/100 ml (8g/l))⁴. Signs of systemic illness (fever, shivering) or pathological blood results. Elevated WBC, CRP) may be seen, but are usually absent. Additional imaging for detecting insufficiency fractures (MRI, CT) or other bone pathologies are recommended.

Avoiding unconscious injection of vial-derived rubber particles during orthopedic intra-articular drug administration (9716)Andreas Hecker¹; Agostino Di Maro; Emanuel F. Liechti; Frank Michael Klenke¹ Inselspital Bern

Background: Vial coring describes the occurrence of small rubber particles, which are formed by needles when perforating vial stoppers. These particles may be aspirated from the vial into the syringe along with the drug. Unconscious injection of rubber particles may increase the risks associated with intra-articular injections, in particular septic arthritis.

This study aimed to analyze the frequency of this phenomenon and possibilities to avoid its occurrence. We hypothesize that coring can be significantly reduced by using a thinner needle for injection than the one used to withdraw the liquid from the vial. We also hypothesized that the use of needles with a filter may avoid vial coring completely.

Methods: 600 vials of 2mL, filled with sodium chloride, were divided into 3 groups (n=200 each). In group one, aspiration from the vials was performed with a standard 18-Gauge needle and the same needle was used to eject the aspirated fluid onto a 10 µm filter paper. In group two, an 18-Gauge needle was used for aspiration. The needle was then replaced for a 23-G needle through which the fluid was ejected onto the filter paper. In group three, aspiration was performed using 18-G needles with implemented 5 µm filters. Afterwards the needle was removed and the fluid ejected onto the filter paper directly out of the syringe. Subsequently, a microscopic analysis of the filter papers was performed.

Results: In none of the 600 specimen, a rubber particle was detected by naked eye. Microscopically, 20 (10%) rubber particles were detected

in group one. In group two, 21 (10.5%) particles were found. In group three, no particles were visualized. The detected particles were mostly cylindrical with a mean length of 77 µm ranging from 29 µm to 214 µm. The mean width was 36 µm with a range from 14 to 83 µm.

Conclusion: Our study shows the occurrence of rubber particles in the injection fluid in 10% of the cases when standard needles are used for aspiration and injection. Using a thinner needle for injection did not reduce the number of particles whereas this phenomenon could be completely avoided when a filter needle with a 5 µm filter was used. We recommend withdrawing drugs for intra-articular injections with such a needle if possible.

Clinical and Patient-Reported Outcomes after Customised Individually Made Total Knee Arthroplasty (9729)

Raphael Kaelin; Nicole Vogel; Markus P. Arnold

Praxis LEONARDO, Hirslanden Klinik Birschof

Introduction: Classical knee arthroplasty is subject to different problems that can negatively influence the clinical outcome. Rotational and coronal malalignment, implant overhang and non-anatomic implant design with altered knee kinematics are only some causes discussed in literature. The idea behind customised individually made total knee arthroplasty (CIM TKA) is to avoid such problems and improve clinical outcome. The purpose of this study was to assess the clinical and patient-reported outcome measures (PROMs) of CIM TKA.

Methods: Since January 2017, we prospectively collect PROMs from patients scheduled for a primary cruciate-retaining CIM TKA (iTotal CR, ConforMIS, Inc., Bedford, MA). The surgeon completed the objective Knee Society Score (KSS) before the surgery and after 12 months

We collected the following PROMs before the surgery, after 12 and 24 months: Knee injury and Osteoarthritis Outcome Score (KOOS), Forgotten Joint Score (FJS-12), EuroQol (EQ-5D-3L) and patient satisfaction. We analysed pre-post data with paired t-tests and calculated the proportion of patients whose results improved at least by the minimal important difference (MID).

Results: We analysed data for 70 CIM TKA after 12 months (61 patients, 48% female) and 42 CIM TKA after 24 months (35 patients, 54% female). Mean patient age at surgery was 67 years (SD 8.7, range 48 to 83), mean KSS was 52 points (SD 11.6, range 19 to 85).

Complete follow-up data will be available in June 2021. We present preliminary results of the first 63 CIM TKA (12 months) and 37 CIM TKA (24 months). Mean KSS improved to 94 points (SD 7.9, range 63 to 103, p <0.001).

All PROMs improved after 12 and 24 months (p <0.001). The proportion of patients with results above the MID ranged from 69% to 90% after 12 months and from 78% to 92% after 24 months. Most patients were very satisfied or satisfied after the surgery: 86% after 12 months and after 24 months, respectively. Complications occurred in three patients: a quadriceps tendon rupture (after 18 months), an arthrofibrosis that required arthrolysis (after 12 months) and one complete revision (after 18 months).

Conclusion: The data on CIM TKA showed very good clinical and patient-reported results including a high patient satisfaction. Future studies have to confirm these in long-term. It will also be of major interest to investigate, if CIM TKA show better postoperative PROMs in comparison to off-the-shelf implants.

Plate-free correction of highly symptomatic genu recurvatum (20 degrees of hyperextension) caused by a negative tibial slope: a case report (9779)Ambra Vitti¹; Pascal Müller Greber; Herzog Richard¹ Spital Wolhusen

Introduction: Genu recurvatum (extension >5°) can be caused by increased posterior joint laxity or by a primary or secondary bone deformity. More common in females, it can be the cause of unspecific anterior

or posterior knee pain and poor proprioceptive control of terminal knee extension, which predisposes patients to future injuries (i.e. PCL-tears).

We report a case of a 24 years old female patient affected by a symptomatic left knee hyperextension of 20° due to a negative posterior tibial slope of 2°, no history of traumatic injury. Over the years the symptoms hadn't shown any improvement under conservative and active therapy (knee arthroscopy with resection of plica mediopatellaris and peripatellar synovectomy/denervation 9 years before), Lysholm Score of 74.

Methods: Full length a.p. and lateral radiographs of the lower left limb were obtained, which revealed a negative posterior slope of 2° and minimal left valgus deformity of 1° with normal patellar height (Insall-Salvati 1.15). Clinical examination showed passive knee hyperextension of 20° (contralateral 10°) without generalized joint hypermobility (Beighton-Score 3). No intraarticular pathologies on MRI.

We planned an anterior opening wedge osteotomy of 6 mm to increase the posterior tibial slope by 9°, resulting in a physiological slope of 7°. The tibial tuberosity was detached and an antero-posterior osteotomy with residual posterior hinge was performed. Three cortical bone grafts were placed at the anterior aspect of the osteotomy site. The tibial tuberosity was placed back and fixed with four bicortical screws. Intraoperative ROM testing showed a reduction of passive hyperextension from 20° to 10°.

Results: No intra- or postoperative complications were observed. At 12-months follow-up the patient reported full satisfaction (Lysholm-Score 100) and was able to participate in long hiking tours without any pain. ROM was symmetrical to the asymptomatic contralateral side (140/0/10°), no changes in cruciate and collateral ligaments tension. Radiographs showed good osseous consolidation and no signs of loosening. Full length lateral lower limb radiographs confirmed a posterior tibial slope of 7°.

Conclusion: A pathological negative posterior tibial slope can be the main cause of a symptomatic Genu recurvatum. A plate-free correction through an anterior open-wedge tibial osteotomy can improve life quality of patients without the need of further surgery.

Feasibility Of Web-Based Patient-Reported Outcome Assessment After Arthroscopic Knee Surgery: The Patients' Perspective (9793)

Martin Olach¹; Jan Meester²; Gerrit Behrens³; Johannes Giesinger⁴; Michael Badulescu¹; Karlmeinrad Giesinger¹

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Introduction: Patient-reported outcome (PRO) assessment has become an important cornerstone to evaluate outcomes in orthopaedics. Dissemination of smartphones and tablets allow for very efficient questionnaire completion and simple data acquisition in hospital and at home. However, it is controversial how patients feel about this novel electronic follow-up in clinical practice.

Methods: Consecutive patients undergoing arthroscopic knee surgery of the meniscus at a large teaching hospital in Switzerland were included. The Computer-based Health Evaluation Software (CHES) was used for data presentation and collection. Electronic questionnaires included the Knee Injury and Osteoarthritis Outcome Score (KOOS), the Forgotten Joint Score-12 (FJS-12) and the Tegner Activity Scale at baseline preoperatively, 6 and 12 weeks, 6 and 12 months postoperatively. At the end of the follow-up period, a questionnaire was sent out to evaluate various aspects of the process of electronic data acquisition from the patients' perspective.

Results: 102 patients were included in the study. Mean age was 50 years. 30 patients refused participation: 9 because of language barrier, 7 because of a lack of internet access (study period 2015-2017), 14 refused without reason. One patient died after baseline assessment. 71 patients (69.6%) participated in the study. Regarding questionnaire completion times a substantial learning effect through subsequent follow-ups was observed already after 3 months. Mean completion time was 5.5 minutes for the KOOS and 1.8 minutes for the FJS-12. 46 patients returned the evaluation questionnaire at the end of the study. 36 patients

(78.3%) reported to have no problems using the tablet computer at baseline assessment. 86.9% were satisfied or very satisfied with the process of survey. 22 patients (47.8%) stated that they would want to have feedback through the questionnaire during the period of aftercare. The majority of patients (48.9%) considered 3 months to be a good interval for periodic questionnaires. 82.2% considered 5-15 minutes as reasonable for this effort.

Conclusion: Electronic patient reported outcome (ePRO) offers the possibility for a feedback loop for patients but also for the attending doctor. The majority of patients consider 3 months as a good interval to answer questions and up to 15 minutes reasonable.

Home-based programs vs standard rehabilitation following knee meniscectomy (9826)

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Importance: Arthroscopic meniscectomy (AM) is one of the most common orthopaedic procedures, but the optimal post-operative approach is still debated.

Objective: To compare the effectiveness of home-based programs (HBP) versus standard inpatient and/or outpatient supervised physical therapy (IOP) following AM.

Data Sources: A systematic literature research was conducted on PubMed, Web of Science, Cochrane Library, and Scopus databases on November 1, 2020.

Study Selection: RCTs of patients treated with HBP versus IOP after AM were included. Non-randomized studies, expert opinions (level of evidence 2-5), systematic reviews, and meta-analyses were excluded.

Data Extraction and Synthesis: Data were independently screened and extracted by two authors according to the Preferred Reporting Items for Systematic Reviews with disagreements solved by consensus. A fixed-effects model was favoured in the absence of significant heterogeneity (I² <25%), otherwise a random-effects model was employed, and the Knapp Hartung correction was applied.

Main Outcomes and Measures: The primary outcome was the Lysholm score and secondary outcomes were subjective IKDC score, knee extension and flexion RoM, thigh girth, horizontal and vertical hop test, and days to return to work, as indicated in the previous PROSPERO registration.

Results: In this meta-analysis of eight RCTs on 434 patients, no statistically significant between-groups difference in Lysholm score was documented, both at short-term, with a standardized mean difference (SMD) of -0.78 (95% confidence interval (CI) = -1.63 – 0.08; p=0.065), and at mid-term, with a SMD of -0.31 (95% CI = -0.67 – 0.05; p=0.095). Similar results were found also for secondary outcomes. A statistically significant between-groups short-term difference emerged only for the vertical hop test score, favouring IOP, with an SMD of -0.42 (95% CI = -0.80 – -0.03; p <0.05). A sensitivity analysis of the primary outcome was also performed and confirmed the study findings.

Conclusions and Relevance: No intervention demonstrated to be more effective in terms of physical outcomes as well as work-related and patient-reported outcomes, both at short- and mid-term follow-up. IOP showed only a slightly more favorable functional outcome in the short-term. Overall results showed HBP to be an effective management after AM in the general population.

Coronal alignment, outliers and operative time in total knee arthroplasty with navigation, patient specific guides or standard instrumentation: a single surgeon series on 274 cases (9915)

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Introduction: Neutral alignment in total knee arthroplasty (TKA) is defined as a hip-knee-ankle angle (HKA) within 3° from neutral and is associated with improved implant survival and function. Several studies reported higher rates of inaccurate positioning and alignment outliers when using standard instrumentation and technique. However, single surgeon clinical series comparing implant positioning and alignment with standard technique (STD), patient-specific instrumentation (PSI) and navigation (NAV) are lacking. Therefore, this study aimed to compare coronal alignment and implant positioning as well as operative time when the three techniques are performed by the same surgeon.

Methods: A single surgeon series of 274 patients who underwent TKA via standard instrumentation (STD), patient-specific guides (PSI) and computer assisted surgery (NAV) was analyzed at a one-year follow-up. The three groups (STD, n=89; PSI, n=94; NAV, n=89) were matched for pre-operative coronal alignment. Pre- and post-operative HKA angles were retrospectively assessed analyzing stereoradiographic images of patients in functional position as obtained through the EOS® System.

Alignment outliers were defined as having a deviation of more than 3° from neutral (HKA <177° or HKA >183°). Operative times were retrospectively assessed on patients' operative reports.

Results: Coronal alignment as measured through the HKA was significantly different between STD and NAV groups (p=0.001), but not between STD and PSI (p=0.4) nor between PSI and NAV (p=0.1). There were 20 (23%) outliers in the STD group, 15 (17%) outliers in the PSI group and 8 (9%) outliers in the NAV group. The operative time was significantly lower in STD procedures (129 ± 3 min) and PSI procedures (126 ± 5 min) when compared with navigation (134.8 ± 9 min) (NAV: PSI p=0.03, NAV: STD p= 0.04, STD: PSI p=0.06).

Conclusion: In the present single surgeon series, TKA performed with navigation resulted in a significant improvement in implant positioning and coronal alignment when compared to standard technique. Moreover, use of navigation resulted in a significant reduction of alignment outliers. No relevant difference in terms of alignment or operative time existed between standard and patient specific instrumentation technique. However, because of the significantly longer operative time and the uncertain clinical benefit, use of navigation is still to be questioned.

CLINICAL AND RADIOLOGICAL OUTCOMES IN PATIENTS AFTER TROCHLEOPLASTY AND MEDIAL PATELLO-FEMORAL LIGAMENT RECONSTRUCTION WITH A MINIMUM 2 YEAR FOLLOW-UP (9948)

Lara Pozzi¹; Peter Brem; Michel Schläppi; Christoph Metzler; Simon Rauch; Samuel Blatter; Peter Philipp Koch; Jean-Romain Delaloye

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Introduction: Trochlear dysplasia is a common risk factor predisposing to recurrent patella dislocation. This pathological morphology leads to a lack of congruence with the patella that occasionally needs to be surgically corrected by deepening the trochlear bone underneath the cartilage, the so-called trochleoplasty. The aim of our study was to evaluate the clinical and radiological outcomes after combined trochleoplasty and medial patello-femoral ligament (MPFL) reconstruction in patients with a minimum two-year follow-up.

Methods: Patients who underwent a combined trochleoplasty and MPFL reconstruction in our institution between January 2014 and July 2018 were eligible for a clinical and radiological assessment.

Clinical examination included patellar apprehension test, Kujala and Tegner score and isometric measurement of quadriceps and hamstring strength.

Radiological studies included radiographs and MRI of the operated knee.

Wilcoxon test was used for comparison of numeric values. Fisher's exact test was used for comparison of frequencies.

Results: Sixteen patients (16 knees) with a mean follow-up of 2.5 years (range 2.0 to 5.5 years) after the operation were available for clinical and radiological assessment. Median age at the time of the operation was 18.5 years (range 13 to 47 years) and trochleodyplasia was classified type B in 3 patients and type D in 13 patients.

Three patients presented a persistent positive patellar apprehension test, but none complained of a recurrent patella dislocation. Postoperative median Kujala and Tegner score were 85 (range 67 to 100) and 4 (range 2 to 10), respectively. Strength of the quadriceps and hamstring of the operated leg was lower than the contralateral side (17% and 9%, respectively). However, this difference did not reach statistical significance.

Post-operative MRI did not show any chondrolysis or subchondral necrosis. However, chondropathy worsened on both patellar and trochlear side compared to pre-operative MRI.

Conclusion: Combined trochleoplasty and MPFL reconstruction is a safe and efficient treatment for patellar instability in patients with high grade trochlear dysplasia. However, increased cartilage deterioration of the patella and trochlea has been identified on MRI performed minimum two years after the operation.

A06 – FOOT

Anterior Intraosseous Dislocation of the Posterior Tibial Tendon: A Case Report (9772)

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Introduction: A 69-year old female patient sustained a twisting low-energy injury to her right ankle. She presented with pain and tenderness to her medial malleolus. Conventional radiographs showed a cortical irregularity over the medial malleolus without any typical fracture signs. CT scan demonstrated an osseous avulsion involving the flexor retinaculum with displacement of the posterior tibial tendon (PTT) underneath the fragment.

Methods: The patient underwent surgical exploration of the PTT 4 days after the injury. The tendon was exposed proximal to the medial malleolus and followed distally along its course. It was running anteriorly of the groove and disappeared underneath the periosteum into the cortical bone. After elevation of the osseous fragment the PTT could be reduced back into its anatomical position in the retromalleolar groove. Examination revealed an intact tendon with only mild fraying. The osseous fragment was anatomically reduced and fixation was performed using two 2.0 mm screws and transosseous sutures. The flexor retinaculum showed no signs of injury.

Results: The postoperative course was uneventful. Full weight bearing in a walking boot with 15° of plantar flexion for 6 weeks was allowed. X-Ray examination 6 weeks postoperatively showed complete consolidation of the avulsed fragment. 12 weeks postoperatively the patient was ambulating without pain. Range of motion of the ankle joint was symmetric. No clinical sign for PTT insufficiency could be detected.

Conclusion: Dislocation of the PTT in absence of an ankle fracture is a rare injury with only a few case reports found in the literature. So far two different types of dislocation are described: a subcutaneous dislocation where the PTT dislocates anteriorly after rupture of the flexor retinaculum, and a subperiosteal dislocation where the retinaculum is avulsed with a periosteal sleeve and the tendon is trapped underneath it. We report the case of a novel type of PTT injury: the anterior intraosseous dislocation. In this case the tendon dislocates anteriorly elevating an osseous fragment and leaving the retinaculum and the medial malleolus intact. Dislocations of the PTT need to be recognized and addressed surgically since they do not qualify for conservative treatment.

Z-lengthening Plasty of the Extensor Hallucis Longus (EHL) Tendon Proximal to the Retinaculum Extensorum to Repair a Chronic Rupture of the Distal EHL Tendon. (9895)

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CHUV & Université de Lausanne

Background: Extensor hallucis longus (EHL) tendon injuries are rare. End-to-end suture is used in acute lacerations or in chronic cases when the tendon stumps are close enough to be attached without excessive tension. If a non-reducible gap exists between the tendon edges, a reconstruction with a graft or a transfer may be necessary to restore the hallux alignment and active dorsiflexion. We present the surgical technique and the post-operative follow up of our method to repair a traumatic EHL rupture with a non-reducible gap by using a Z-lengthening of the EHL tendon proximal to the superior retinaculum of the extensors.

Method: We used two incisions, one at the level of the rupture and the other proximal to the retinaculum of the extensors. After the preparation, we measured the distal gap between the stumps. We then identified the EHL tendon through the proximal approach and lengthened it with a Z-shaped incision to gain the needed length distally. End-to-end suture could then be performed at the level of the rupture, without tension. Full weight bearing in a lower leg cast was allowed 24 hours after surgery. After two weeks, the patient received a dynamic splint with a dorsiflexion counter spring for another 4 weeks. After 6 weeks, normal shoes were allowed and physical therapy was started consisting in sessions with progressive active training twice a week for another 6 weeks. The muscle strength was estimated clinically at 6 weeks and 3 months in

comparison to the healthy side. AOFAS, FAAM and EQ 5D 5L scores were administered at 3 months postoperatively.

Results: At 3 months, our patient recovered an active hallux extension of 50° at the metatarsophalangeal joint (60° on the healthy side). There was no loss of active or passive plantarflexion in the metatarsophalangeal or interphalangeal joint. There were no wound complications. We observed no dysfunction and no secondary deformities of the foot at follow up. The FAAM score was 83/84 (activities of daily living) and 12/12 (sports). The AOFAS was 90/100 and the EQ-5D was 0.8.

Discussion: This repair of the EHL using a Z-lengthening plasty of the tendon proximal to the retinaculum has not been previously described. Based on our case this technique appears safe, simple and affordable to treat the EHL ruptures if the end-to-end direct suture is not possible, thus eliminating the need for an allograft or the risk of secondary dysfunctions potentially associated with tendon transfer procedures.

Below Knee Amputations in Central Switzerland Between 2009 and 2019 (9970)

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Introduction: Primary below knee amputations (BKA) are often the last option in surgical treatment for many medical conditions and are performed by different surgical subspecialties. Amputations are often times performed in order to save a patient's life.

We therefore asked, (1) what is the survival rate of BKA amputees in Switzerland, (2) how do these rates differ between different surgical subspecialties, and (3) how did these rates change over time?

Methods: Retrospective review of all patients undergoing a BKA at one of three hospitals of the same public hospital group consisting of two level 2 rural hospitals and one level 3 main hospital between January 2009 and December 2019 resulted in 98 BKA. Survival rates were calculated according to Kaplan-Meier and Cox regression analysis performed to identify risk factors.

Results: Thirty-two patients died at a mean of 1.1 years (range 0-4.2 years) after BKA at a mean age of 74.3 years (50.9-98.9). The half year, 1-year, and 2-years survival rate of patients undergoing BKA is 82.0% (95% confidence interval [CI] 74.3-89.8%), 75.2% (95% CI 66.0-84.3%), and 71.9% (95% CI 62.1-81.7%) respectively.

The main reason for Burgess amputation was ischemia in 53%, diabetes in 19%, infection (w/o diabetes) in 15%, trauma in 9%, and other causes in 4%.

Burgess amputations were performed by vascular surgeons in 42%, by orthopaedic and trauma surgeons in 41%, and general and visceral surgeons in 17%.

Risk factors for death after BKA are secondary wound closure (hazard ratio [HR]= 7.996, p-value= 0.011), ASA score (HR= 5.409, p-value= 0.001), and high diastolic A. brachialis blood pressure (HR = 1.098, p-value= 0.041).

Conclusion: Survival of patients undergoing BKA is low. There was no relevant change of survival rate over the course of the observation period. Several risk factors for death after BKA were identified.

Clear cell sarcoma of the anterior tibial tendon: A case report (10027)

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Introduction: Clear cell sarcoma (CCS) is a rare malignant tumor few described in the literature, with a predilection for lower extremities and a tendency to involve tendons and fascia. Patients usually present late while the disease is progressing without them noticing it. late symptom because of the slow progression of the disease. Clinical and radiological

findings are not sufficient. Histological and immunohistochemical analysis are necessary to make the diagnosis. The effective treatment is surgical by carcinological tumor resection.

Case presentation: We report the case of a 47 years old male patient undergoing initial biopsy-excision surgery of a lesion labeled tenosynovial giant cell tumor on MRI. After histological and immunohistochemical analysis, the diagnosis showed a clear cell sarcoma of the anterior tibial tendon. The patient underwent an extensive revision surgery .

Results: The immunohistochemical results correspond to a high-grade clear cell sarcoma with translocation of the EWSR1 gene. The extension workup after initial excision showed no tumor residue or lesions suspicious of distant metastasis. The pathology results of the post-relapse are favorable and consistent with resection in a healthy area.

Conclusion and outlook: The patient did not present any local or systemic recurrence and showed a good function of his anterior tibial tendon plasty at the 1-year follow-up.

Key words: clear-cell sarcoma, soft tissue tumor, anterior tibial tendon

A071 – PEDIATRIC ORTHOPEDICS

A new subtype of Galeazzi-equivalent injury? Case report (9790)

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Introduction: Displaced distal metaphyseal ulnar fractures and distal radial buckle fractures are quite common among children but their association has never been reported in literature to our knowledge. Thus, classification and management of this pattern remain challenging especially in young children. A Galeazzi-equivalent injury should be suspected.

Methods: We report the case of a 2-year-old boy who presented the above-mentioned association of forearm fractures with a certain displacement between both bones. We compare our management with actual recommendations through a literature review. Informed consent was obtained.

Results: Initial clinical assessment of our patient was difficult because of his age and pain. He needed a closed reduction of the ulnar fracture under general anesthesia. Immobilization was maintained for 8 weeks. Clinical and radiological evolution were good. No residual pain, no range of motion limitation and no distal radio-ulnar joint (DRUJ) instability were observed after a five-month follow-up.

Conclusion: Galeazzi-equivalent injury combines an ulnar epiphyseal avulsion associated with metaphysis displacement and a radial fracture in children. This pattern is infrequent although probably underestimated. The initial clinical assessment of the DRUJ could indeed be complicated in young patients, by pain and swelling. Most of these injuries are treated by closed reduction and immobilization. Reported results in literature are quite good but misdiagnosed lesions or improper treatment could also compromise the DRUJ stability, the wrist and forearm range of motion, and generate chronic pain. We would recommend a low suspicion threshold for DRUJ instability in young children presenting a displaced distal metaphyseal ulnar fracture associated with a distal radial buckle fracture. That suspicion should impact treatment and follow-up.

A rare Case of Brucellosis in Switzerland: Osteomyelitis of the Pediatric Foot (9806)Franziska Kocher¹; Nermine Habib²; Sabah Sid'Amar³; Moritz Tannast¹; Ines Raabe¹

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INTRODUCTION: Brucellosis is one of the most common zoonotic bacterial infections in developing countries. Transmitted mainly by drinking unpasteurized milk, children seem to be more often affected than adults. Undulating fever, fatigue, musculoskeletal pain are common symptoms. Osteoarticular involvement is the most frequent complication; affecting most frequently the sacroiliac and spinal joints. Diagnostic measures include physical examination, laboratory tests, radiological imaging, and biopsies for microbiological and histological analysis. Treatment of osteoarticular brucellosis is by antibiotic therapy; however, surgical treatment is necessary in case of non-responsiveness to antimicrobial therapy.

METHODS: A case presentation of an 8-year-old boy admitted to our hospital due to increasing left foot pain and swelling. Known for recurrent episodes of polyarticular arthritis, he was being treated by a rheumatologist with analgesics and cortisone infiltrations for approximately six months. On clinical examination, he presented with swelling and erythema of the ankle and of the midfoot and associated with pain and limited range of motion. Laboratory findings showed normal inflammation parameters.

Standard radiographs and ultrasonography of the foot demonstrated signs of osteomyelitis of the navicular bone with a concomitant abscess around the talonavicular joint confirmed by magnetic resonance imaging (MRI).

RESULTS: Surgical debridement of the navicular bone and packing with gentamicin-impregnated foam was performed. Initially, the intraopera-

tive microbiological biopsies were negative; however, the Brucella-specific agglutination test, IgM-IgG combined antibody test and the eubacterial PCR resulted positive. The initial treatment with co-amoxicillin (amoxicillin + clavulanic acid) was replaced after 3 days by gentamicin. After two weeks, the gentamicin substituted by oral rifampicin and doxycycline for a total therapy of 3 months.

At our postoperative follow-up at 6 months, the patient was completely healed, asymptomatic and had recovered complete range of motion.

CONCLUSION: Brucellosis is a rare cause of osteomyelitis in children in Switzerland, but its consequences may be disastrous if missed. Brucellosis should be considered as a differential diagnosis in patients, especially immigrants, with unspecific symptoms, including joint pain and fever. We also recommend PCR analysis in case of negative microbiological cultures.

Extensor pollicis longus (EPL) tendon laceration after elastic stable intramedullary nailing (ESIN) of shaft fractures of radius in children with nail insertion at Lister's tubercle: we report four cases. (9820)

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Introduction: ESIN is an established method for treatment of unstable forearm shaft fractures in children. Two entry points for retrograde intramedullary nailing of the radius are described: proximal to the growth plate in line with the styloid process or to second at the Lister's tubercle. The latter is commonly chosen for metaphyseal distal fractures. A lesion of the EPL tendon as a complication after ESIN is reported at a rate of 1.5% to 1.9%. As the tendon passes ulnarly to the Lister's tubercle it is prone for lesion as it has direct contact with the ESIN.

Methods: We report 4 cases operated from February 2019 to October 2019 of children aged 11 years and 1 month and 14 years and 3 months (mean 12.8 years) who underwent reduction and stabilization of forearm fractures with ESIN where the entry point of the nail was chosen at the Lister's tubercle, who subsequently developed an EPL lesion in zone 7. The lesions were diagnosed before hardware removal and in one case intraoperatively during hardware removal thus 12 to 32 weeks after osteosynthesis on average 22.8 weeks. In three patients a 100% tendon rupture was present and in one case a 90% lesion. We suppose the lesions to be caused by friction, as the nails were introduced by an open approach. One EPL was reconstructed by extensor indicis-transfer and one with a palmaris longus transplant. The incomplete EPL lesion was sutured and reinforced with an extensor carpi radialis brevis graft. The fourth patient demonstrated some active retropulsion and extension at the interphalangeal joint. An ultrasonography showed adhesions between the ruptured EPL and the intact extensor pollicis brevis. This explains the remaining function of the thumb. As the patient was not bothered he denied revision together with his parents. During the same period, a total of 24 children underwent operative stabilization with ESIN of the radius.

Results: Over a period of 10 months there was a significant number of EPL tendon lesions in our department of 16,7% as the entry point for the ESIN was chosen at the Lister's tubercle.

Conclusion: The entry point ulnar to the Lister's tubercle for ESIN for osteosynthesis in diaphyseal radius fractures in children must be avoided in order to prevent laceration of the EPL tendon.

First humerus lengthening osteotomy with a magnet-operated intramedullary nail in Switzerland – a preliminary case report (9944)

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Introduction: Distraction osteogenesis is an appreciated technique to correct limb shortening of various etiologies. An external fixator is commonly used to ensure 3D dimensional correction and lengthening. However, intramedullary devices have been showing similarly good results over the last decade providing a more comfortable distraction procedure with reduced risk of infection at the same time.

Purpose: To present the first case of humeral lengthening and operative technique using a magnet-operated intramedullary nail in Switzerland.

Methods: A 13-year-old girl with humeral shortening of 5 cm resulting from traumatic upper plexus palsy of the right arm during birth was

treated with humeral osteotomy and implantation of a motorized intramedullary nail (PRECICE® magnet-operated Internal Bone Lengthening Nail, Ellipse Technologies, Inc, Irvine, CA, USA) for gradual lengthening. Individualized lengthening was performed using varying distraction rate in support of nervous tissue.

Results: The humeral lengthening of 5 cm was successfully achieved without complications 78 days after the beginning of distraction. The range of motion for the elbow and shoulder did not decrease during the lengthening or the current follow-ups. Implant removal will be performed after consolidation. Distraction and consolidation rate was analyzed.

Conclusion: This is the first case of an intramedullary motorized femoral nail which was used for humeral lengthening in Switzerland. No intra- or postoperative complications occurred and the patient could perform lengthening in an out-patient clinical setting. Intramedullary lengthening of the humerus with a motorized nail might be an appropriate alternative to external fixators.

Level of evidence: IV

Key words – humerus, lengthening, intramedullary, motorized nail, pediatric, Precice

A072 – INFECTIONS

Low-grade implant infection with *Brucella melitensis* (9587)

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Introduction: In Switzerland Brucellosis is a rare zoonotic infection that may present with atypical symptoms, delaying diagnosis and treatment. Cases are generally associated the consumption of unpasteurized dairy products in endemic regions. A detailed patient history including a travel history is a crucial part in clinical routine.

Case: A 65-years-old patient originating from Turkey presented with pain in the left knee and lower limb for the past 4 months. The patient had a history of a car accident 20 years ago with a fracture of the proximal tibia requiring internal fixation and the implant still in situ. The clinical examination only showed a slight pain over the scar on the proximal lateral tibia. In the laboratory analysis CRP (32 mg/l) was slightly increased. A haematogenous low-grade implant-related infection was suspected. In a Single-Photon Emission Computed Tomography (SPECT/CT) a focal accumulation was detected at the tibial implant. Blood cultures drawn initially to detect an endocarditis lenta showed the growth of *Brucella melitensis*. The second pair taken four days apart proved the consistent of continuous bacteraemia. Antibiotic therapy was started. A transoesophageal echocardiography was unremarkable. The implant was removed after two weeks of antibiotic treatment. In the sonication of the implant specific polymerase chain reaction (PCR) -analysis for *Brucella melitensis* was positive. In a detailed anamnesis, the patient reported consumption of unpasteurized milk during her last travel to Turkey, 1 month prior to the symptoms onset and 5 months prior to diagnosis.

Conclusion/Discussion: The presented case is representative for the classical features of brucellosis associated with a rare but relevant complication. Brucellosis is a zoonosis endemic in many parts of the world including the Mediterranean Basin. The most common mode of transmission is the consumption of unpasteurized dairy products. The incubation time ranges from 5 to 60 days. Most (90%) infections are asymptomatic. Symptoms include undulating fever, malaise, headache and fatigue. The infection may spread to the liver, spleen or bone. Cardiac involvement is rare. In the presented case with persistent bacteraemia, it remains speculative, if the initial asymptomatic infection lead to a localised symptomatic presentation and secondary endocarditis or vice versa. Brucellosis is considered a biological hazard and precaution measurements should be put in place.

Asymptomatic periprosthetic joint infection of the hip with high-virulence pathogens: report of two cases (9603)

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Introduction: We report two cases of periprosthetic joint infection (PJI) after total hip arthroplasty (THA) with highly virulent pathogens but asymptomatic clinical and radiological presentation over years despite the absence of treatment. There are no similar reports available in the literature.

Methods: A 27 year old female with severe anorexia underwent staged bilateral THA for avascular necrosis. 1 month postop on the left side she developed acute PJI with *S. aureus*. Low volume aspiration allowed no cell count. The patient's anorexia was poorly controlled with impending liver failure and severe hyponatraemia. Revision surgery was not possible due to prohibitive general conditions. The patient refused antibiotic treatment. Over the next weeks the patient became afebrile and denied further symptoms. At the 1 year mark she is ambulating without discomfort. X-ray show well fixed components without signs for loosening.

A 74 year old obese and diabetic female underwent right sided multi stage revision THA for an acute polymicrobial PJI. 6 years later the patient complained about persistent right sided hip pain. Blood works were normal. Joint aspiration showed pathological cell count (226'300 leucocytes/ μ l) and grew *S. lugdunensis*. Revision surgery was scheduled but

could not be performed due to an in-hospital fall which caused an open ankle fracture necessitating multiple procedures. After 3 months the patient was asymptomatic. Revision was therefore indefinitely postponed. 4 years later the patient still denies symptoms to her hip. X-ray show a well fixed cup. The uncemented stem shows a radiolucent line around its shoulder but has not subsided in 10 years. In absence of hip and/or thigh pain we conclude that the implants are properly integrated.

Results: The cases described are neither representative for classic manifestation nor for state of the art final management of PJI.

Conclusion: The fact that high-virulence pathogens can colonize implants over time without causing symptoms or mechanical failure is a rarity so far and both cases need further observation. Both PJIs reported have not been treated surgically following standard guidelines because of adverse clinical circumstances. When surgery is not a viable option suppressive antibiotic therapy can be considered. Therapeutic abstinence however might be an alternative to long-term antibiotic suppression in selected cases, despite not being mentioned as an option in any guideline.

Epidural abscess related to *Streptococcus mitis* in a 57 year-old immunocompetent patient (9706)

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Introduction: Spinal epidural abscess, a collection of pus or inflammation between the thecal sac and surrounding tissue, is a rare condition in healthy adult patients, known for an incidence of 2.4 cases per 100 000 persons. Around half of the cases are due to a haematogenous spread, and almost a third because of a discitis spread. The most frequent microorganism is *Staphylococcus aureus* for 50 to 65% of cases, followed by gram negative bacilli such as *Escherichia coli* (18%) and *Pseudomonas* species in intravenous (IV) drug users. Usually seen in adults aged more than 60 years, risk factors include: immunodeficiency, HIV infection, malignancy, immunosuppressive treatments and IV drug abuse. Adequate timely diagnosis of spinal epidural abscess is crucial because around one fourth of patients may develop motor deficit or paralysis. We describe here the case of a healthy patient who presented a lumbar spinal epidural abscess related to a dental infection, without any risk factor.

Methods: A 57 year-old immunocompetent male patient presented himself to our emergency department because of a ten-day duration lumbar pain, after a lumbar torsion. He was neurologically intact, but showed a biological inflammatory syndrome. A lumbar MRI found a spinal epidural abscess from L3-L4 to L5-S1 levels. The patient was operated early before occurrence of neurological deficit. The abscess cultures found a *Streptococcus mitis* infection.

Results: The patient presented good recovery after surgical decompression, washout with samples and targeted antibiotic therapy for six weeks.

Conclusion: In the present case, we think that, considering a pain-free period before the lumbar torsion of the patient, an insidious onset of L5-S1 spondylodiscitis related to *Streptococcus mitis* spreading from a dental cavity may have been decompensated during the torsion and have released bacteria around the dura mater, leading to abscess formation. The final collapse of the L5-S1 disc on lumbar MRI at the 6-week follow up argued in favour of this hypothesis.

Vertebral osteomyelitis due to anaerobic bacteria *Veillonella parvula*: Case Report and literature review. (9854)

Daniele Gianoli; Michal Ziga; Frederike Waldeck; Cyrill Dennler; Rainer Schlichtherle; Thomas Forster; Benjamin Martens; Roman Schwizer

Study design: Case report and literature review.

Objective: Presentation of a case report of a *Veillonella* vertebral osteomyelitis in a 79-year old man and review of literature.

Introduction: While pyogenic vertebral osteomyelitis due to Gram-positive aerobic bacteria and its treatment is well known, vertebral osteomyelitis caused by anaerobic Gram-negative pathogen is rare. In particular, the vertebral osteomyelitis caused by *Veillonella* species is an absolute rarity. Thus no established management recommendations exist.

Methods: A case report of a 79-year-old man with *Veillonella* vertebral osteomyelitis with intramuscular abscess collection managed conservatively with stand-alone antibiotic therapy without a spinal stabilization procedure.

A review of literature of all reported *Veillonella* vertebral osteomyelitis was performed.

Results: After 3 week-intravenous therapy with the ceftriaxone in combination with the metronidazole followed by 3 week-peroral therapy with amoxicillin/clavulanate, the complete recovery of the patient with the *Veillonella* species infection was achieved.

Conclusion: Treatment of the *Veillonella* vertebral osteomyelitis should contain a betalactam with betalactamase inhibitor or third generation cephalosporine. Six weeks of treatment seem to be sufficient for the complete recovery of the patient.

Results of arthroscopic debridement for early post-operative and acute hematogenous periprosthetic knee infections compared to open surgery (9883)

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Introduction: Periprosthetic joint infection is a serious orthopaedic complication. Today we know different types of treatment, direct-exchange arthroplasty and two-stage resection arthroplasty with re-implantation, treatment with debridement and implant retention (DAIR) with component retention. DAIR can be performed open or arthroscopically. Aim of our study was to assess treatment efficacy of arthroscopic versus open DAIR for periprosthetic knee infection. Secondary, we assessed the relationship between disease and patient factors and the need for re-operation due to recurrent infection.

Materials and Methods: In this retrospective study which included patients with a periprosthetic knee infection who were treated with either arthroscopic or open ID between 01/2005 and 05/2015 at the university hospital of Basel. During the study period no specialised multidisciplinary team (MDT) for the treatment of PJI existed, thus the decision was at the discretion of the surgeon on call. Inclusion criteria were (1) McPherson type I infection or McPherson type II infections, (2) patients having a primary total knee arthroplasty, and (3) at least two years' follow-up after arthroscopic or open DAIR.

Results: A total of 47 patients (48 knees) were included (42 TKA and 6 rTKA). Fourteen patients (14 knees; 29%) were treated with arthroscopic DAIR. Of these, 7 patients (50%) were successfully treated after initial surgery. The remaining 7 patients (50%) returned to the operating room because of persistent/uncontrolled infection. Two had another arthroscopic DAIR while 5 were converted to open DAIR. Thirty-three patients (34 knees; 71%) had an open DAIR. Of these, 24 patients (24

knees; 71%) were successfully treated after initial surgery. Due to persistent PJI, the remaining 9 patients (10 knees) needed a second DAIR during the same hospital stay. Patients undergoing arthroscopic DAIR were 2.4 times more likely to need re-operation as patients undergoing open DAIR for periprosthetic knee infection (OR 2.4; 95% CI (0.67- 8.64; p= 0,181).

Discussion: The success rate of our open DAIR procedures are inferior to data published in the literature but still are significantly better than the results from the arthroscopic DAIR cohort. With the implementation of a MDT we hope to improve the quality of our open DAIR procedures. Furthermore, the authors would not recommend to perform arthroscopic DAIR as a routine procedure.

Septic arthritis of the shoulder due to *Ureaplasma urealyticum* after emergency caesarean section: a case report (9916)

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Background: *Ureaplasma urealyticum* is an intra-cellular bacterium frequently found colonizing the genital tract. Known complications include localized infections, which can result in premature deliveries. Septic arthritis due to *U. urealyticum* in healthy patients is exceptionally rare, although opportunistic septic arthritis in agammaglobulinemic patients have been reported. However, there are no reports of septic arthritis due to *U. urealyticum* following caesarean section or in the post-partum period.

Case presentation: A 38-year-old immunocompetent woman presented with severe right shoulder pain, 1 month following emergency caesarean section at 26 weeks of gestation for pre-eclampsia and spontaneous placental disruption with an uncomplicated post-operative recovery.

Our suspicion of septic arthritis was confirmed with abundant pus following arthrotomy by a delto-pectoral approach. Awaiting culture results, empirical antibiotic treatment with intravenous amoxicilline and clavulanic acid was initiated. In spite of sterile cultures, clinical evolution was unfavorable with persistent pain, inflammation and purulent drainage, requiring two additional surgical débridement and lavage procedures.

The 16S ribosomal RNA PCR of the purulent liquid was positive for *U. urealyticum* at 2.95×10^6 copies/ml, specific cultures inoculated a posteriori were positive for *U. urealyticum*. Levofloxacin and azithromycine antibiotherapy was initiated. Susceptibility testing showed an intermediate sensibility to ciprofloxacin and clarithromycin. The strain was susceptible to doxycycline. Following cessation of breastfeeding, we started antibiotic treatment with doxycycline for 4 weeks. The subsequent course was favorable with an excellent functional and biological outcome.

Conclusions: We report the first case of septic arthritis due to *U. urealyticum* after caesarean section. We hypothesize that the breach of the genital mucosal barrier during the caesarean section led to hematogenous spread resulting in purulent septic arthritis. The initial beta-lactam based antibiotic treatment, initiated for a purulent arthritis, did not provide coverage for cell wall deficient organisms. Detection of 16S rRNA allowed for a correct microbiological diagnosis in a patient with an unexpected clinical course.

A073 – TUMORS

Internal hemipelvectomy through a peri-acetabular osteotomy combined with an extraarticular (proximal) femur resection using a single posterolateral approach – a new surgical technique (9601)Robbert van Leeuwen¹; Bruno Fuchs²; Martin Beck³¹ Luzerner Kantonsspital Luzern; ² Luzerner Kantonsspital & the Swiss Sarcoma Network; ³ Orthopädische Klinik Luzern AG

Introduction: To reach the best oncological perspective in intra-articular, periacetabular- and/or proximal femur tumors, a radical extra-articular periacetabular resection is necessary. In this case report we present an extra-articular periacetabular resection technique through a posterolateral approach to the hip. This surgical technique is relatively unknown in tumor surgery of Enneking type II lesions.

Cases: Three patients with malignant tumor growth in the hip joint were treated with a wide, extra-articular resection of the hip joint, conducted through a posterolateral approach. Reconstruction was realized in 2 cases with a Burch-Schneider reinforcement cage, in the other case with a LUMIC prosthesis. In all three cases, the short follow-up showed excellent functional outcome and only one minor complication; a subcutaneous hematoma for which transfusion was necessary.

Conclusion: This approach to the hip joint shows promising results in treating tumors of the periacetabular region. Further research to discover long term functional outcomes is necessary.

Gluteal flap coverage for sacrectomy to compensate for biopsy induced soft tissue contamination (9708)Fernanda Critelli¹; Bruno Fuchs²¹ Luzerner Kantonsspital Luzern; ² Luzerner Kantonsspital, Kantonsspital Winterthur, UniversitätsSpital Zürich USZ, Universitätskinderhospital Zürich

Introduction: Sacral chordomas are locally aggressive tumors that grow slowly causing subtle symptoms usually. Surgery of these tumor aims at complete en bloc resection, which because of its close relation to neural elements, may be associated with important functional consequences for bowel and bladder continence. The placement of the biopsy is therefore extremely important not to contaminate further tissues to be resected.

Methods: A 49 year-old patient presented with a history of 8 year long sacral pain. She did not note any reduced sensation and muscular weakness, no bowel or bladder incontinence. Preoperative MRI guided us in identifying a 52x55mm sacral chordoma of S3 and S4 body in close contact to S3 roots right. Staging studies with CT showed small two lung nodules. A biopsy was performed from laterally to reach the anterior portion of the tumor, potentially sparing the neural elements. Preoperative underwent the patient photon therapy.

Results: A posterior midline skin incision with inclusion of the entire biopsy tract from laterally was performed necessitating on the left side the mobilization of the gluteus maximus muscle. Wound was exposed to the tip of the coccyx and pelvic ligament (sacrospinous and sacrospinous) were found and sectioned, lower border of pyriformis muscle was identified and dissected. We identified the dural sac with exiting sacral roots, especially S2 and S3 bilaterally. The identified sacral nerve roots are traced laterally outside the sacral foramen and we resected the S3 root right which direct in relation with tumor was. The osteotomy level was decided based on the tumor extent and performed; the sacrum was gently lifted up with tumor and the removed bone with tumor was sent for histopathological examination. A left gluteus maximus advancement muscle flap was used to fill the defect. At 6 month-follow-up, the patient was pain free and no local or distal recurrence after 29 months follow-up.

Conclusion: Surgery is the mainstay for local control of sacral chordoma. Biopsies need to be performed strictly from posteriorly in the midline. If mistakenly it is carried out from laterally, additional soft tissue resection requires the usage of additional tissues to reconstruct the large posterior sacral defect. This may lead to increased morbidity, should be avoided and highlights the importance of defining the biopsy tract preoperatively in a multidisciplinary team.

Novel surgical technique to reconstruct a large soft tissue defect of the Adductor Compartment after sarcoma resection (9712)Fernanda Critelli¹; Mario Scaglioni¹; Gabriela Studer¹; Bruno Fuchs²¹ Luzerner Kantonsspital (LUKS); ² Luzerner Kantonsspital, Kantonsspital Winterthur, UniversitätsSpital Zürich USZ, Universitätskinderhospital Zürich

Introduction: Sarcomas of the adductor compartment are particularly prone for postoperative, specifically wound complications. Resection of this type of tumors requires wide margins, and the large defects usually are associated with compromised perfusion, specifically subsequent to preoperative radiation therapy. These resulting defects are usually deep and frequently expose the femoral vessels without any possibility to cover with healthy tissue, reason why it is usually advocated to bring in fresh tissues. However, there is continued debate of what reconstruction technique is preferentially used.

Methods: A 85 year-old male noticed a history of painless progressive swelling in the left thigh of 11x9,7x8,2 cm. MRI demonstrated a mass located in adductor magnus muscles. Staging studies with PET-CT showed lung metastases. A biopsy revealed an undifferentiated pleomorphic sarcoma (UPS) G3 and the patient underwent preoperative radiation therapy with 5x5=25 Gy. It was decided to surgically resect this lesion with a limb-sparing resection and using pedicled DIEP flap coverage.

Results: We performed the incision from posteromedial aspect of thigh to the inguinal region; this is followed by careful dissection to identify pectineus, adductor longus muscles and then the interval between femoral vessels. The adductor longus, brevis and magnus muscles were carefully detached from their insertions on the femur throughout its length to the adductor hiatus. The sciatic nerve was identified and preserved. The tumor was exposed and completely removed after resection of adductor from their origin (superior and inferior pubic rami) and along the obturator foramen. The coverage of the inguinal region was created with a deep inferior epigastric (DIEP) flap; with a lymphovenous anastomosis (LVA) onto the flap with confirmation of its patency with ICG. Postoperative course was uneventful without any sign of infect. Postoperative underwent the patient adjuvant chemotherapy with Doxorubicin.

Conclusion: Soft-tissue sarcomas arising within the adductor muscle group represent a specific challenge, and wound healing complications are frequently observed, reason why flap coverage is often used. Herein, we present the use of a pedicled DIEP sandwich technique in combination with LVA onto the flap. This represents a novel concept of coverage, not only addressing the coverage of a large defect but also simultaneously the reconstruction of lymph vessels.

Salvage of massive Giant Cell Tumor of the Proximal Tibia using a fresh osteochondral Allograft (9726)Nikolaus Floimayr¹; Peter Philipp Koch²; Bruno Fuchs¹¹ Luzerner Kantonsspital Luzern; ² Kantonsspital Winterthur (KSW)

Introduction: The transplantation of osteochondral allografts is a joint preserving procedure for large combined defects of the subchondral bone and cartilage that furthermore facilitates the reestablishment of hyaline cartilage. Indications include posttraumatic defects, osteonecrosis, osteochondritis dissecans and tumors, mainly of the ankle and knee. Here we present a case of a patient with a massive Giant Cell Tumor (GCT) of the proximal tibia, treated with resection and reconstruction with fresh osteochondral allograft.

Methods: A 35 year old male patient presented with left medial knee pain for 4 months. Imaging revealed a 64x57x55 mm expansive, heterogenous, partially liquid lesion with cortical erosions of the left proximal tibia. Biopsy showed multinucleated giant cells of the osteoblastic type. Curettage of the meta- and diaphysis including the subchondral bone but preserving the joint cartilage as well as cementation was performed. Postoperatively denosumab treatment was used. During the following 24 months, progressive destruction of the articular surface occurred. To

postpone arthroplasty the decision was taken to transplant a fresh osteochondral allograft and medial meniscus.

Results: The medial collateral ligament was separated and kept in the soft tissue sleeve en bloc. The cement was completely removed and the cartilage of the medial tibial plateau together with the meniscus resected. The defect of the proximal tibia was prepared and the allograft adjusted so that a proper axis in extension and medial stability was achieved. As the allograft was 3-4 mm underdesigned the intercondylar region was slightly widened. To correct the slope a small wedge was placed in the dorsal diaphysis. The osteochondral allograft was reduced, the meniscus secured to the capsule with sutures, the medial collateral ligament fixed and a Tomofix plate placed. At 2 years follow-up, the patient showed a remarkable functional outcome being able to walk without crutches, impaired only by residual medial instability, and was fully reintegrated to his standing profession.

Conclusion: Giant cell tumors of the bone are characterized by aggressive growth. Joint involvement often ends in arthroplasty. Especially for young patients, transplantation of an osteochondral allograft might delay joint replacement and can provide good functional outcome in selected cases.

Accuracy of the sarcoma diagnosis in a swiss referral center A comparative Analysis from the SwissSarcomaNetwork (9809)

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Introduction: Soft tissue tumors are rare tumors and histological examination remains a challenge. The diagnostics and treatment planning of soft tissue tumors are critically dependent on the pathological examination. The French sarcoma network has established the importance of secondary expert path reading by pathologists who see more than 300 tumors a year. In Switzerland, pathological analysis is established locally, and then sometimes secondarily reviewed by a reference pathologist. Herein, we assess the accuracy of the diagnosis from the local pathologist compared to the diagnosis from the reference pathologist.

Method: We examine retrospectively all pathology reports from a Swiss referral center between January 2019 and December 2020. All reports were presented at the SwissSarcomaBoard and were reviewed secondarily by the reference pathologist. Patients with incomplete records were excluded. We categorized the accuracy in groups A, B and C, according to the classification which was presented 2014 in „sarcoma“ (1). Cases without no discrepancy in diagnosis were classified under category A. Category B includes cases with minor discrepancy in diagnosis with no therapeutic consequences. Category C contains all cases, where the diagnosis from the reference pathologist changed the treatment.

Results: 196 patients with a biopsy as a prime diagnosis were included in the study. Overall, category A comprised 149 patients (76.4%), category B 21 patients (10.8%) and C 25 patients (12.8%).

Analysis of malignant tumors, makes the discrepancies even more pronounced compared to the overall results.

Conclusion: The pathological examination of soft tissue tumors by an expert pathologist is highly recommended, as in 16% from all malignant biopsies there is a significant change in the therapy after expert review

References: 1. THWAY, Khin, et al. Histopathological diagnostic discrepancies in soft tissue tumours referred to a specialist centre: reassessment in the era of ancillary molecular diagnosis. *Sarcoma*, 2014, 2014. Jg.

Intraarticular Nodular fasciitis of the hip joint (9873)

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Purpose: We present a case of an intra-articular nodular fasciitis (NF) of the hip, which is a rare benign lesion usually arising from subcutaneous, fascial or subfascial sites of the upper extremities, followed by the head and neck, trunk and lower extremities. To our knowledge, there is only one other report in the literature of an intra-articular occurrence in the hip.

Case: A 50-year-old man complained of groin pain on the right side for 3 months. The clinical examination of the hip revealed a positive anterior impingement sign and a moderate tenderness on palpation in the groin. The MRI of the hip showed an extensive synovialitis and joint effusion and an increased alpha angle 64° (norm <50°) as a correlate for a Cam impingement. A diagnostic and therapeutic arthroscopy was performed for biopsy, complete synovectomy and offset correction. The histological result revealed an unspecific aspect with mucoid changes comparable to ganglion cysts, no sign of malignancy. 4 month after the arthroscopy the symptoms still remained. The new MRI showed a significant growth of the intra-articular tumor around the neck of the hip. To obtain a new histology, a CT aided biopsy was performed. As a NF kept in mind, molecular-genetic next generation sequencing detected a MYH9-USP6 gene-fusion.

Discussion: Most cases in the literature describe a joint involvement of the knee. The symptoms vary from pain in the affected joint to joint effusion, painful mass, catching sensation and limited range of motion. The MRI usually identifies a lesion with an iso- to hypointense signal in T1- and a hyperintense signal in T2-weighted sequences. Histologically, it is defined as a benign proliferation of fibroblasts and myofibroblasts, abundant spindle-shaped cells, which are arranged within a variably loose myxoid to collagenous stroma. Immunohistochemically, the spindle cells are positive for alpha-smooth muscle actin (SMA). The identification of a MYH9-USP6 gene fusion by RT-PCR is described as a useful tool to corroborate the diagnosis. The therapy consists of arthroscopic resection with good result. The published case reports showed no recurrence after resection, in our case we observed a re-growing mass after about 4 months. After 1 year we haven't performed a reoperation with a sub symptomatic patient.

Conclusion: We describe a rare intra-articular NF of the hip, which, in contrast to the published cases, presented with a recurrence after arthroscopic resection.

Downgrading Giant Cell Tumor of the bone with Denosumab (9934)

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Introduction: Giant cell tumor of bone (GCTB) is a benign, locally aggressive, giant cell-rich neoplasm that commonly affects young adults. GCTB may be locally aggressive and local recurrence is challenging.

Denosumab is a human monoclonal antibody that specifically inhibits osteolysis by preventing RANKL-mediated formation and activation of multinucleated osteoclasts or giant cells from RANK-positive mononuclear preosteoclasts and macrophages. Indications for Denosumab (Prolia) are treatment/prevention of idiopathic osteoporosis, osteoporosis induced by hormonal treatment and in higher dose as XGEVA for metastatic bone tumor problems and benign GCTB.

After initial widespread use of XGEVA for GCTB about 10 years ago, euphoria has waned and indication, dosage and duration of treatment are discussed controversially. Our index patient received 6 injections of XGEVA over 4 months with 120 mg/injection. He showed a local recurrence one year after surgical therapy. We decided to start the therapy with a short neoadjuvant use of XGEVA with the aim of less tumor regression and improved tissue quality when surgical curettage is performed.

We wish to share our experience with a short neoadjuvant treatment protocol hoping to learn more from discussion with the audience.

Methods: 3 patients with biopsy proven diagnosis of GCTB (locations distal radius; proximal fibula; neck of the femur) received neoadjuvant XGEVA weekly over 30 days with 120 mg/injection.

After completion of above XGEVA protocol, local treatment consisted in curettage and cement filling in 3 patients. In a 68 year old lady with GCTB of the distal radius the cement spacer was left in place and she is asymptomatic at 3 years F/U. In the other patients, the cement spacer was removed and the defect biologically reconstructed with autologous or homologous bone transplant.

Results: A total of 3 patients were treated. The mean follow up was 48 months. 2 of the 3 cases showed no local or systemic recurrence.

One case with recurrence of GCTB at the proximal fibula underwent a wide resection.

At the time of the last follow up all 3 cases were without recurrence.

Conclusion: The short time application showed a satisfactory macroscopic re-modeling which made the curettage easier and enhanced the quality of tumor resection. The local recurrence rate was 33% in our small cohort which seems to be encouraging. We would like to discuss if a shorter application time of XGEVA is superior to a longer treatment protocol.

A08 – BASIC RESEARCH

Bildbasierte Analyse der Ultrastruktur des humanen Kniegelenk-Knorpels mittels Synchrotron-Radiation- μ CT (9731)

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Fragestellung: Ein detailliertes Wissen über die Architektur des Gelenkknorpels ist essentiell zur Entwicklung und Weiterentwicklung von Therapieverfahren der manifesten Osteoarthritis (OA). Vorangehende Arbeiten haben histologisch festgestellt, dass sich Chondrozyten abhängig vom Degenerationsgrad zu charakteristischen räumlichen Mustern anordnen. Die Nutzung dieser Muster als bildbasierte Biomarker für OA wurde vorgeschlagen. Die bisher veröffentlichten Daten beziehen sich ausschliesslich auf Chondrozyten in der oberflächlichsten Probenregion. Das Ziel dieser Arbeit war es, mittels Synchrotron-Radiation-microCT (SR- μ CT) eine Technik zur hochauflösenden, zellulären und dreidimensionalen Darstellung, Untersuchung und Kartographie des humanen Kniegelenk-Knorpels über alle Knorpelschichten zu etablieren und somit sowohl die absolute Position der Zellmuster im Knorpel, als auch die dreidimensionale Ausdehnung der OA visualisieren zu können.

Methodik: Humane, arthrotisch veränderte Femurkondylenresektate wurden zu Zylindern (20x3x3 mm) präpariert, mit röntgenkontrastverstärkenden Antikörpern gefärbt und mittels SR- μ CT digitalisiert, segmentiert und qualitativ analysiert. Histologische Aufnahmen vor und nach der μ CT dienten der quantitativen sowie der vergleichenden qualitativen Analyse.

Resultate: Sowohl der makroskopische Knorpelschaden, als auch die räumliche Zellanordnung konnte dargestellt und die vorbeschriebenen Muster re-identifiziert werden. Die Anordnung der Muster folgte dem Ausmass der makroskopischen Degeneration. Die μ CT-Technik erlaubte die Beurteilung der gesamten Probe und somit die absolute Lokalisation der Zellmuster im Knorpel. In Zonen mit intakter Knorpeloberfläche wurde auch in tieferen Schichten eine physiologische zelluläre Anordnung vorgefunden. In Zonen mit Knorpeldefekten wurden die typischen veränderten Zellmuster angetroffen. Die Schwere der Veränderungen der Zellorganisation war zwei- und dreidimensional stark mit der makroskopischen Gewebeerstörung assoziiert.

Schlussfolgerung: Diese Pilotstudie belegt den dreidimensionalen Zusammenhang räumlicher Chondrozytenorganisation mit der Knorpeldegeneration. Frühe Veränderungen der Zellorganisation in der superfiziellen Zone sind mit Veränderungen in tieferen Schichten assoziiert. Da Veränderungen von Strings zu Double Strings bereits ohne makroskopisches Korrelat erkennbar sind, könnte dieses Werkzeug die einfache Erkennung früher degenerativer Veränderungen des Knorpels ermöglichen.

Use of Aspirin versus Rivaroxaban in postoperative thromboembolic prophylaxis after primary total hip and knee arthroplasty (9936)

Simon Donkerwolke; Jean-François Fischer; Philip Deslarzes; Sami Abou-Khalil; Thibaut Royon

eHiv Hôpital Yverdon Les Bains

Goal of the study: To compare the efficiency of Aspirin and Rivaroxaban in the thromboembolic prophylaxis after Total Hip (THA) and Knee (TKA) Arthroplasty: a multicenter comparative retrospective study.

Introduction: The Total Hip and Knee Arthroplasties have seen an increase in recent years due to population aging, leading to more thromboembolic post-operative complications. Different drugs are effective in preventing these complications, but none of them stands out. To this date, we are not aware of any Swiss studies comparing the effectiveness of Aspirin with that of Rivaroxaban. The main objective of the study is to find out whether Aspirin is as effective as Rivaroxaban in thromboembolic prophylaxis in primary THA and TKA.

Patients and methods: Multicenter comparative retrospective study including all patients who underwent primary THA or TKA between January 2017 and November 2020, in two different hospitals. Patients who presented previously thromboembolic event, admitted for fracture or revision surgery, or under preoperative therapeutic anticoagulation were excluded.

All included patients received postoperative thromboembolic prophylaxis for a total of 4 weeks, with Heparin during hospitalization period followed by Rivaroxaban 10 mg once a day or by Aspirin 100 mg twice a day. The rehabilitation protocol was the same for all (full load bearing from day zero or day one). We used our computer database files to search thromboembolic events and deaths occurring within 90 days after surgery. SPSS statistical software and the Chi2 test were used.

Results: 828 patients were included (58 % THA: n = 481; 42 % TKA: n = 347). 54,5 % (n = 451) took Rivaroxaban and 45,5 % (n = 377) took Aspirin. Two cases of Deep Vein Thrombosis were observed with Aspirin (0.53 %), none occurred with Rivaroxaban. The difference was not significant (p = 0.125). We did not observe any deaths or pulmonary embolism. The two cases of deep vein thrombosis belong to the THA group, none occurred in TKA.

Conclusion: Aspirin and Rivaroxaban both appear to be effective in preventing thromboembolic events after primary THA or TKA. Aspirin offers the possibility of rapid surgical revision in the event of post-operative hematoma or early acute infection, does not require laboratory monitoring and has very few side effects. Its low cost and availability are also advantages. The exact dosage and the minimum prescription period remain controversial, requiring further randomized studies.

Titanium trabecular 3D electron beam melting implants: A new promoting bone growth material (10003)

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Introduction: Bone growth is an important entity in the process of fracture healing and bone fusion. Spinal fusion is the major procedure in order to obtain stability in degenerative or traumatic conditions. The ideal material should be osteoinductive and osteoconductive leading to rapid bone growth. The aim of this study is to present the new porous trabecular titanium (PTT), 3D electron beam melting (EBM) designed, and the perspective of use in orthopedic and spine surgery.

Methodology: Description of the basic research on porous trabecular titanium and the different derived product already used. The porous trabecular titanium 3D EBM is nowadays used in cervical and lumbar cages (MT Ortho, Aci Sant'Antonio, Sicily, Italy). This material is actually under investigation in the form of titanium microspheres as cement replacement. The safety, biomechanical proprieties, risks and benefits of each products are analyzed.

Results: In vitro studies have shown that porous trabecular titanium 3D EBM are osteoinductive and osteoconductive. It was demonstrated in

the cervical cages that the bone matrix could rapidly adhere and grow in the cage, leading to quick segmental stabilization. Preliminaries studies show a fusion rate in 83.3% of the patients and bony growth through the cage in 100% at 3 months. For the titanium microsphere, a preclinical study has shown good biomechanical stability. A first phase clinical study on 15 patients has confirmed the biomechanical stability and demonstrates less risk such as cement leak, temperature damage or pulmonary embolism.

Discussion: Porous trabecular titanium 3D electron beam melting is a promising material in bone growth stimulation. It can be used in a large variety of implants. In spine surgery, it allows rapid bone growth which is an imperative condition for fusion and segmental stability. The same material is also used in fractures as a cement replacement leading to greater stability and better bone healing with fewer complication risks. The osteoinductive and osteoconductive properties of the PTT 3D EBM can be exploited in orthopedic surgery, such as in important bony defects, avascular necrosis of bone or traumatic bone loss.

Conclusion: Porous trabecular titanium can be widely and safely used as a bone growth stimulator. The potential of product development based on porous trabecular titanium is encouraging for further therapeutic use in pathology needing a rapid bone growth.

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