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Wir danken allen Ärztinnen und Ärzten, die Tag für Tag zur Wiedereingliederung von Verunfallten beitragen.

Unser Dank gilt den kompetenten Ärztinnen und Ärzten und dem engagierten Pflegepersonal, aber auch den Arbeitgebern und den Betroffenen selber. Denn ihnen allen ist es zu verdanken, dass immer mehr Menschen nach einem Unfall wieder in ihr gewohntes Leben zurückkehren können. Nähere Informationen über das Case Management der Suva unter www.suva.ch/unfall.

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SWISS ORTHOPAEDICS

80TH ANNUAL MEETING

E-CONGRESS, AUGUST 27, 2020

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FM2

Outcomes of reverse total shoulder arthroplasty for postinfectious joint sequels *(8195)*

Dr. Philipp Kriechling; PD Dr. Samy Bouaicha; Dr. Octavian Andronic; Prof. Dr. Ilker Uçkay; David Bock; Dr. Karl Wieser

Balgrist Universitätsklinik

Background: The outcomes of elective Reverse Total Shoulder Arthroplasty (RTSA) surgery for the sequels of former septic native joint shoulder arthritis are unknown, but might be inferior to patients without prior bacterial arthritis.

Methods: Single-center case-control study embedded in our prospective RTSA cohort. We matched all patients with prior infections 1: 1 ratio to arthropathies for other reasons. The matching variables were: age, sex, dominant/non-dominant shoulder, and body-mass-index. We evaluated outcomes by Constant Score and active function.

Results: Among 1249 patients in the RTSA cohort, 14 were operated for sequels of previous native shoulder joint infections. Although both groups significantly improved from preoperative to postoperative values, the outcome of postinfectious patients was clearly inferior in comparison with the control group (Absolute (38 ± 17 vs. 75 ± 8, p <0.01) and relative Constant score (47 ± 19 vs. 88 ± 9, p <0.01), Constant pain score (11.0 ± 3.1 vs. 14.3 ± 1.3, p <0.01), and Subjective Shoulder Value (43 ± 26 vs. 85 ± 10, p <0.01)). Moreover, in the postinfectious group, overall surgical complication occurred in 36%, with the need for revision in 21%. There was, however, no recurrence of infection in any of the patients shoulders.

Conclusion: Elective RTSA for end-stage postinfectious joint disease is associated with a high number of complications and reoperations. Its success is furthermore clearly inferior compared to cases without past infection.

Key words: Post-arthritis sequels; reverse total shoulder arthroplasty; outcomes; group comparisions; handicap

FM3

Augmented Reality for base plate component placement in Reverse Total Shoulder Arthroplasty *(8196)*

Dr. Philipp Kriechling; Dr. Simon Roner; Florentin Liebmann; Dr. Fabio Casari; Prof. Dr. Philipp Fürnstahl; Dr. Karl Wieser

Balgrist Universitätsklinik

Background: Accurate glenoid positioning in reverse total shoulder arthroplasty (RSA) is important to achieve satisfying functional outcome and prosthesis longevity. Optimal component placement can be challenging, especially in severe glenoid deformities. The use of patient specific instruments (PSI) and 3D computer assisted optical tracking navigation (NAV) are already established methods to improve surgical precision. Augmented reality technology (AR) promises similar results at low cost and ease of use. With AR, the planned component placement can be superimposed to the surgical situs and shown directly in the operating field using a head mounted display. We introduce a new navigation technique using AR via head mounted display for surgical navigation in this feasibility study, aiming to improve and enhance the surgical planning.

Methods: 3D surface models of ten human scapulae were printed from computed tomography (CT) data of cadaver scapulae. Guidewire positioning of the central back of the glenoid baseplate was planned with a dedicated computer software. A hologram of the planned guidewire with dynamic navigation was then projected onto the 3D-created models of the cadaver shoulders. The registration of the plan to the anatomy was realized by digitizing the glenoid surface and the base of the coracoid with optical tracking using a fiducial marker. After navigated placement of the central guidewires, another CT imaging was recorded, and the 3D model was superimposed with the preoperative planning to analyze the deviation from the planned and executed central guides trajectory and entry point.

Results: The mean deviation of the ten placed guidewires from the planned trajectory was 2.74° +- 1.25° (95% CI 1.85°; 3.64°). The mean deviation to the planned entry point of the ten placed guidewires measured 2.26 mm +- 1.11 mm (95% CI 1.46 mm; 3.06 mm).

Conclusion: AR may be a promising new technology for highly precise surgical execution of 3D preoperative planning in RSA.

FM4

Impact of humeral and glenoid component variations on range of motion in reverse geometry total shoulder arthroplasty. A standardised computer model study. *(8214)*

Dr. Antonio Arenas-Miquelez[1]; Dr. Richard Murphy[2]; Andrea Rosa; Davide Caironi; Prof. Dr. Matthias Zumstein[2]

[1] Inselspital Bern, Universtität Bern; [2] Orthopädie Sonnenhof

Introduction: This study, based on computer simulation, aimed to evaluate the influence of humeral design, humeral neck shaft angle (NSA), glenoid lateralisation and glenoid eccentricity on impingement-free range of motion in reverse total shoulder arthroplasty (RTSA). Modifications of RTSA, since the first Grammont design, have developed with the aim of improving range of motion (ROM) and avoid notching. Previously published literature in this area directly compared different brands of prosthesis without standardisation of parameters such as humeral offset and acromiohumeral distance, thereby limiting the external validity of such work.

Methods: We created a three-dimensional computer model from CT scans of 13 patients with primary osteoarthritis and simulated implantation of standardised RTSA, controlling for humeral offset and acromiohumeral distance. We analysed the effect of four different variables on impingement-free range of motion: humeral stem design (Inlay, Semi-Inlay, Onlay), humeral NSA (135°, 145°, 155°), glenoid lateralisation (+0mm, +4mm, +12mm) and glenoid eccentricity (central, 2mm inferior, 2mm postero-inferior) on ROM.

Results: Variation in humeral stem design did not have a significant effect on total global ROM. Reducing NSA demonstrated a significant increase in adduction, ER-1 and IR-1, although with a decrease in abduction and ER2. Glenosphere lateralisation led to the largest increase in total global ROM, however, extreme lateralisation (+12mm) did not show significant benefit compared to moderate lateralisation (+4mm). Glenosphere eccentricity increased only adduction and IR-1 with 2mm inferior positioning.

Conclusion: Only glenoid lateralisation has a significant effect on increasing total global ROM in RSA. No humeral configuration showed greater total ROM than any other, rather a different arc or motion, confirming that surgeons must make a compromise on ROM when selecting a prosthesis. The use of the Semi-Inlay 145° model combined with 4mm lateralisation and 2 mm inferior eccentricity represents the middle ground and the most universal approach in RTSA.

FM5

The "Circles Method" for acromioclavicular joint injury evaluation and classification *(8215)*

Dr. Richard Murphy; Dr. Piotr Lesniewski; Dr. Wolfan Alcantara; Annabel Hayoz; Prof. Dr. Matthias Zumstein

Orthopädie Sonnenhof

Introduction: This study aimed to validate a novel radiographic measurement of displacement in acromioclavicular joint (ACJ) injuries, permitting improved, objective classification. Defining ACJ injuries remains inadequate due to imperfect means of radiographic assessment, leading to controversy over what constitutes vertical and horizontal displacement and instability. As a result, watershed injuries (ISAKOS defined Rockwood IIIA/IIIB) and those with isolated horizontal instability (Rockwood IV) can be difficult to reliably identify and, therefore, manage effectively and consistently.

Methods: We developed a simple radiographic parameter, the "Circles Method", measured on an Alexander view of the shoulder: centre-centre distance from circles drawn within the distal clavicle and anterior

acromion. Radiographs and CT of sawbone models mimicking Rockwood I-V injuries were taken including up to 20° projectional error in three planes. We validated "Circles Method" absolute values through correlation with CT displacement, effect of projectional error and intra-/inter-observer reliability in raters of varying experience. Difference between injured and uninjured sides was used to assess discriminant validity in defining Rockwood grade. "Circles Method" was subsequently trialled in a retrospective clinical cohort (n=95).

Results: The "Circles Method" showed extremely high correlation with true CT displacement: Pearson correlation coefficient 0.970 for neutral radiographs, 0.933 with +/-10° and 0.889 with +/-20° projectional error. Inter- and intraobserver agreement was extremely high: ICC 2,1 = 0.977 in both cases. Measured difference between injured and uninjured sides demonstrated reliable identification of stable injuries (Rockwood I, II, IIIA) at <7mm, watershed injuries (Rockwood IIIB) between 7 and 14mm and unstable injuries (Rockwood IV and greater) at >14mm.

Conclusions: "Circles Method" is a simple, reliable, validated means of measuring true displacement in ACJ injuries, which remains robust in the presence of rater inexperience and projectional error. This measurement and the described watershed levels can improve definition of injury severity and appropriateness of subsequent management.

FM6

The risk of postoperative scapular spine fracture following reverse shoulder arthroplasty is increased with an onlay humeral stem *(8259)*

Georges Haidamous; PD Dr Alexandre Lädermann[1]; Mark Frankle; Patrick Denard

[1] *Hôpital de La Tour*

Background: The purpose of this study was to assess the effects of lateralization and distalization on scapular spine fracture (SSF) following reverse shoulder arthroplasty (RSA). The hypothesis was that postoperative distalization would be associated with an increased risk of SSF, but that increasing lateralization would not be associated with it.

Methods: A multicenter retrospective review was performed at a minimum of 1 year postoperatively on primary RSAs with 3 different implants, two with an inlay design (n = 342) and one with an onlay design (n = 84). Functional outcome, range of motion (ROM), stem design (inlay vs. onlay) and radiographic measurements, including acromiohumeral distance (AHD) and lateralization were compared between groups with and without fracture.

Results: The incidence of SSF in the onlay group (11.9%) was significantly higher compared to the inlay group (4.7%) (p = 0.043). Postoperative AHD was approximately 4 mm higher in the SSF group (37.5 mm) compared to the control group (33.7 mm) (p = 0.042). There was no difference in lateralization between the 2 groups (52.8 vs. 53.9 mm; p = 0.362). Higher return to activity (92.1% vs. 7.9%; p <0.001) as well as postoperative forward flexion were observed in the group without fracture compared to the group with SSF (135° vs 120°; p = 0.009).

Conclusion: Increased postoperative distalization of the arm is associated with an increased risk of scapular spine fracture following RSA, and is influenced by component design. An onlay humeral stem design resulted in a 10 mm increase in distalization compared to an inlay humeral stem, and a 2.5 times increased risk of scapular spine fracture. On the other hand, lateralization does not appear to increase the risk of postoperative scapular spine fracture.

FM7

Radiographic Parameters Associated With Excellent Versus Poor Range Of Motion Outcomes Following Reverse Shoulder Arthroplasty *(8260)*

Georges Haidamous; PD Dr Alexandre Lädermann[1]; Robert Hartzler; Bradford Parsons; Evan Lederman; John Tokish; Patrick Denard

[1] *Hôpital de La Tour*

Introduction: The purpose of this study was to evaluate the relationship of component size and position to postoperative range of motion following reverse shoulder arthroplasty (RSA). The hypothesis was that increased lateralization, larger glenospheres, and a decreased acromiohumeral distance would be associated with excellent postoperative range of motion (ROM).

Methods: A retrospective multicentre study was performed at a minimum of 1 year postoperatively on 160 patients who underwent primary RSA with a 135° humeral component. Outcomes were stratified based on postoperative forward flexion (FF) and external rotation (ER) into excellent (n = 42), defined as FF >140°and ER >30°, or poor (n = 36), defined as FF <100°, ER <15°. Radiographic measurements of lateralization and distalization, as well as component features were compared between the two groups.

Results: A larger glenosphere size was associated with an excellent outcome (p = 0.009). A 2 mm posterior offset humeral cup (p = 0.012) as well as an increased inferior glenosphere overhang (3.1 mm vs. 1.4 mm; p = 0.002) were also associated with excellent outcomes. Acromial – center of rotation distance and glenosphere lateral offset trended toward, but did not reach statistical significance (42.6 mm vs. 39.4 mm; p = 0.072), (27.2 mm vs. 25.8 mm; p = 0.089), respectively. Humeral lateralization and distalization were not associated with an excellent outcome. In multivariate analysis inferior glenosphere overhang remained significant in all models.

Conclusion: Larger glenosphere size and inferior positioning as well as posterior humeral offset are associated with improved postoperative ROM following RSA with a 135° humeral component.

FM8

Scapulothoracic Alignment in B Glenoids. An in Vivo Dynamic Analysis *(8261)*

PD Dr Alexandre Lädermann[1]; Caecilia Charbonnier

[1] *Hôpital de La Tour*

Background: Glenohumeral osteoarthritis (OA) with B glenoid is initiated by progressive posterior static humeral head subluxation. The exact cause of this static posterior translation is not yet elucidated. It has certainly been associated with glenoid version and humeral torsion. It could also simply be the result of bone adaptation resulting from other causes such as unbalanced muscle activity. The scapula is held in place and positioned to axial skeleton only via acromioclavicular joint and 17 muscular attachments. Changes kinematic of the scapula may influence the relative position of the glenoid fossa and, consequently, glenohumeral joint. As the relationship of the scapula to the thorax varies between individuals, such variability may be another factor in the development of various erosion patterns. As such, the aim of this study was to evaluate and to compare the position of scapula in normal and B glenoids. We hypothesized that different scapular positioning could be observed between normal and pathological sides. This information may improve our understanding of glenohumeral pathoanatomy and posterior glenoid erosion patterns and assist with AO prevention.

Methods: Using a patient-specific 3D measurement technique coupling medical imaging (CT) and optical motion capture, we compared scapulothoracic alignment in 7 patients with pathologic B0 and healthy contralateral sides.

Results: The mean superior scapulothoracic distance was 74.6 mm +/_14.9 mm (range, 62.5 to 103.5 mm) and 77.7 mm +/_ 10.7 mm (range, 62.9 to 95.7 mm) for pathologic and control sides, respectively (P=0.5769). The mean inferior scapulothoracic distance was 102.1 mm +/_18.5 mm (range, 78.0 to 134.1 mm) and 107.9 mm +/_ 12.3 mm (range, 82.1 to 119.6 mm) for pathologic and control sides, respectively (P=0.4439). Maximal amplitudes were limited in the pathologic side compared to the healthy one.

Conclusion: A pathologic positioning of the scapula on the thorax did not seem to explain the development of B glenoid.

FM9

Could Subtle Obstetrical Brachial Plexus Palsy Explain Unilateral B Glenoid? *(8262)*

PD Dr Alexandre Lädermann[1]; Dr Philippe Collin; Luc Favard; Elhassan Bassem; George Athwal

[1] Hôpital de La Tour

Introduction: Glenohumeral osteoarthritis (OA) with B glenoid is initiated by progressive posterior static humeral head subluxation. The exact cause of this phenomenon remains unknown. We noted that these patients often report history of perinatal problems. Therefore, we hypothesized that B glenoid morphology would be induced by subtle neurological lesions whilst birth delivery, exhibited by obstetrical brachial plexus palsy (OBPP).The aim was to analyse perinatal complications related to OBPP in patients suffering from static posterior instability.

Methods: The authors retrospectively studied a multicentric series of 154 patients (68% men, 187 shoulders) aged 63±17 years, suffering from static posterior subluxation of the humeral head (B0 to B2 glenoids) between May 2018 and August 2019. The authors asked the patients to complete a questionnaire comprising their age, gender, involved side, dominance, familial history, and history of perinatal complications either related to OBPP development (macrosomia >4kg, shoulder dystocia, fetal distress, maternal diabetes, breech delivery, clavicle fracture, multiple pregnancy, forceps and suction) or not (umbilical cord around neck, prematurity).

Results: The condition was unilateral in 78.6% of cases. Ten patients (6.5%) reported one perinatal complication unrelated to OBPP, including prematurity (n=8, 5.2%) and umbilical cord around neck (n=2, 1.3%). Thirty patients (19.5%) reported one or more perinatal complications related to OBPP, including shoulder dystocia (n=4, 2.6%), macrosomia>4kg (n=5, 3.2%), breech delivery (n=6, 3.9%), multiple pregnancy (n=3, 1.9%), fetal distress or pH>7.1 (n=8, 5.2%), maternal diabetes (n=2, 1.3%), clavicular fracture (n=2, 1.3%), and forceps (n=4, 2.6%). The comparison with the literature suggests that our rates of perinatal complications related to OBPP is much higher than in the general population, notably for shoulder dystocia (2.6% vs 0.2-0.8%), macrosomia>4kg (3.2% vs 0.1%), breech delivery (3.9% vs 0.1%), fetal distress or pH>7.1 (5.2% vs 1.1%), clavicular fracture (1.3% vs 0.2%), and forceps (2.6% vs 0.1%).

Conclusion: Neurological lesions might be an underreported cause of static posterior instability. This information may improve our understanding of glenohumeral pathoanatomy and posterior glenoid erosion patterns as well as assist with OA prevention.

FM10

Evaluation of three different rehabilitation protocols after rotator cuff repair, and the effectiveness of water/pool therapy. A randomized control study *(8264)*

Dr Alec Cikes; Dr Fayssal Kadri; PD Dr Alexandre Lädermann

Background and purpose: Exercises performed in water have shown to improve strength and range of motion in various joint pathologies. This study aims to assess what is the best rehabilitation protocol for patients who undergo arthroscopic rotator cuff repairs, and the effectiveness of a pool therapy protocol.

Methods: Patients who underwent arthroscopic rotator cuff repairs, for small to medium sized rotator cuff tears, with small to moderate retraction of the affected tendon, operated on between 2013 to 2016, were randomized in 3 different groups at the time of surgical indication.

Groups:

1. Patients who underwent rehabilitation with physical therapy, with no aquatic protocol. The "Dry group"
2. Patients who underwent rehabilitation with physical therapy, including an aquatic protocol. The "Pool Group"
3. Patients who performed self-rehabilitation only, with no physical therapist. The "Self Group"

Follow-up: all patients were assessed by an independent observer. The mean outcome measures consisted of pre and post-operative SSV, Constant score, and patient satisfaction. Patients were followed-up at 4, 8, 12 weeks post-operatively, as well as 1 and 2 years.

Results: Group 1 (Dry group) and Group 2 (Pool group) showed better Constant scores at 2 months post-operatively, although not statistically significant. However, patients in group 2 (Pool group) showed statically better Constant scores and overall satisfaction at 3 months post-operatively. All groups had similar results at 6 months, 1 year and 2 years post-operatively, with slightly better outcomes for the Dry and Pool groups compared to the Self group.

Conclusion: Water/pool therapy after rotator cuff repair yields better early results compared to traditional "dry" rehabilitation or self-exercise therapy. The results remain better overtime for patients who underwent pool or dry rehabilitation at 1 and 2 years post-operatively compared to the patients who underwent a self-exercise program, although the difference is not statistically significant on the long term.

FM11

The natural history of small to medsize subscapularis tendon tears *(8282)*

Dr. Anita Hasler[1]; Dr. Andrew Ker; Dr. Tina Paloma Passon; PD Dr. Samy Bouaicha; Dr. Karl Wieser

[1] Universitätsklinik Balgrist

Introduction: No information is currently available on the prevalence or rate of tear progression in subscapularis tendon tears. The purpose of this study was to evaluate the radiographic outcomes of a consecutive series of patients with a symptomatic small to midsize subscapularis tendon tear treated non-operatively.

Methods: All patients with an isolated or combined subscapularis tear treated non-operatively between 1999 and 2019 were identified from our MRI and clinical database. Patients with an MRI scan at a minimum of 5 years follow-up were included. 21 patients with a mean age of 52.5 years (range 26.6-64.8, SD 9.3) were enrolled. The mean follow-up was 8.6 years (range 5.6-12.6, SD 1.8). Initial and last follow-up MRI scans were used to determine concomitant cuff lesions, size of the tear, fatty infiltration of the muscle and biceps pathology. All MRI scans were reviewed by a shoulder and a radiology fellow, with continuous data given as a mean value of the two readers values. A consensus was achieved for all patients regarding the type of tear and biceps pathology.

Results: Three patients had an isolated subscapularis lesion; 7 patients had a concomitant tear of the of the supraspinatus; and 9 patients also had a supraspinatus as well as ventral infraspinatus tear. At time of diagnosis, 14 patients had a type 1 subscapularis lesion as classified by Lafosse et al; 4 patients had type 2 lesions; and 3 patients had type 3 lesions. Nineteen patients (90%) were found to have a progression of the subscapularis tear at last follow-up, according to the Lafosse classification. None irreparable type 5 lesion could be detected at last follow-up. Also, the size of subscapularis tendon tears increased significantly with a mean area of 100mm2 (range: 0-397, SD 88.4, $p < 0.001$). At final MRI scan, the grading of fatty infiltration increased by 1 grade in 4 cases, and also by 2 grades in 4 cases. Nine patients were diagnosed with a new subluxated biceps tendon at last follow-up and 6 patients with a new rupture of the tendon.

Conclusions: After a mean of 8.6 years almost all subscapularis tendon tears progressed in size on MRI scan. Fatty infiltration of the subscapularis muscle remained stable in around half of the study group. However, in the observed time period, none of the subscapularis lesions became irreparable.

FM12

Shoulder abduction strength measurement using a hand-held luggage scale: a pilot study in 76 shoulders *(8296)*

Dr Arun Thangavelu[1]; Dr Gregory Cunningham[2]

[1] Hôpital Pourtalès - Réseau hospitalier neuchâtelois; [2] Hôpitaux universitaires de Genève (HUG)

Introduction: Shoulder abduction strength is a crucial criterion for evaluation of shoulder function. To date, numerous assessment devices have been proposed and validated, but most of them remain expensive or complex to use. The purpose of the study was to carry out a preliminary comparative analysis between a simple and readily available handheld luggage scale (Go Travel spring luggage scale, Go Travel, London, UK) and a validated and widely used isometric dynamometer (MicroFet2, Hoggan Health Industries, The Netherlands).

Methods: Shoulder muscle strength was assessed in 76 shoulders of 38 consecutive patients at a minimum of 6 months following rotator cuff repair involving the supraspinatus tendon, in order to constitute an operated group (group 1) and a control (group 2) group. A mean of three measurements was calculated using both devices by the same observer with device placed on the wrist of the patient standing, shoulder abducted to 90° in the plane of the scapula and internally rotated so the thumb was facing down. Paired t-test was used to compare strength measurements between groups. Results are presented as mean difference, 95% confidence intervals (CI). P value <0.05 was considered statistically significant whereas a mean difference of more than 1kg was considered as clinically significant (2 points on the Constant Score). Statistical analyses were performed with IBM SPSS Statistics (version 23.0.0 for MAC.OSX).

Results: Since both groups were dependant, baseline characteristics were identical (age, sex ratio, dominance) with a mean age of 58.7 years (range, 39-80), 60.5% males and 92.1% right handed. Mean follow-up was 6.9 months (range, 6-12). The mean difference between both measurement methods was of 0.57kg in Group 1 (95% CI; -0.52; -0.10: P<0.005) and 0.54kg in Group 2 (95% CI; -0.60; -0.07; P= 0.013).

Conclusion: These results suggest that measuring shoulder muscle strength in abduction using a hand-held luggage scale yields the same results than an isometric dynamometer in normal shoulders and after rotator cuff repair. It may be an inexpensive readily available and practical alternative device for every day clinical use.

FM13

Subjective shoulder value for instability as an alternative to the Rowe score *(8327)*

Dr Adrien Mazzolari[1]; PD Dr Joe Chih-Hao, Chiu[2]; PD Dr Alexandre Lädermann[1]

[1] Hôpital de la Tour, Genève; [2] Chang Gung Memorial Hospital

Aim: To evaluate the correlation between the Rowe score and the subjective shoulder value for instability

Background: Several scores have been proposed in the literature to evaluate shoulder instability such as the western Ontario shoulder instability (WOSI), Walch-Duplay and Rowe scores. Although these multiple-item questionnaires can give useful and specific information, they remain long to fill and difficult to understand for patients, leading to frustration, waste of time and incomplete forms. In contrast, the use of single assessment numeric evaluation (SANE) scores has recently gained widespread owing to their high interpretation value and simplicity. Different authors already reported their significant correlations with functional scores (Constant or ASES scores), but remain however non-specific to any shoulder pathology. Therefore, the authors adjusted the classic subjective shoulder value according to glenohumeral instability (SSV-Instability) and hypothesized that this new score would have a high correlation with the Rowe score.

Methods: The authors prospectively evaluated a consecutive series of 250 patients (260 shoulders) treated surgically or conservatively for shoulder instability between November 2017 and November 2019, for whom the Rowe score and the SSV-Instability were collected before treatment (n=136) and/or after treatment. The SSV-Instability was assessed with the following question: "What is the overall percent value of your shoulder if a completely stable shoulder represents 100%?". Post-treatment scores were stratified by follow-up periods: 6 to 12 weeks (n=60), 12 to 26 weeks (n=20), 26 to 52 weeks(n=19), 52 to 104 weeks(n=43) and beyond 104 weeks (n=76). Correlations were tested using the Pearson's coefficient (r) and interpreted as very high (r=0.90—1.00), high(r=0.70—0.89), moderate(r=0.50—0.69), low(r=0.30—0.49) or negligible(r=0.00—0.29).

Results: The correlation between the Rowe score and the SSV-Instability was high before treatment(r=0.71), and moderate/high after treatment at 6 to 12 weeks (r=0.60), 12 to 26 weeks(r=0.69), 26 to 52 weeks(r=0.65), 52 to 104 weeks(r=0.73) and beyond 104 weeks (r=0.74) (p <0.001).

Conclusion: This study demonstrated a significant correlation between the Rowe score and the SSV-Instability for both pre- and post-treatment evaluation of shoulder instability. Owing to its high simplicity, the SSV-Instability could be used as an alternative to the Rowe score for iterative patient follow-up

FM14

4 years of clinical experience using an evidence based treatment algorithm for proximal humerus fractures – a prospective comparative study *(8331)*

PD Dr. Christian Spross[1]; Dr. Vilijam Zdravkovic; Melanie Manser; Matthijs Jacxsens; Prof. Dr. Bernhard Jost

[1] Kantonsspital St.Gallen

Background: The first two years of using an evidence based treatment algorithm (TA) for proximal humerus fractures (PHF), based on patient specific factors (age, demands, bone quality, fracture type) have been encouraging in terms of outcome, patient satisfaction and complication rate. We updated the algorithm aiming for further improvement and simplification. Now, we present the 4 year overall data and a comparison of the new version (V2) to the first version (V1) of our TA.

Materials and methods: From January 2014 – December 2017 we prospectively included all patients with isolated proximal humerus fractures. Patients' quality of life was assessed at the time of fracture (EQ-5D), then they were treated according to the TA, whenever possible. Follow-up included clinical and radiographic examination after 3 and 12 months. In the first two years Version 1 (V1) and in the second two years Version 2 (V2) was used. Outcome parameters were: EQ-5D, relative Constant Score (CS), Subjective Shoulder Value (SSV), complication and re-operation rate.

Results: Totally 334 patients (68% female) with a mean age of 66 years (range 18-97) were included. The fracture patterns were: 152 1-part (45.5%), 122 2-part (36.5%) and 60 3-/4-part (18%). Overall, 226 patient (68%) were treated conservatively, 60 with ORIF (21%), 39 with reverse total shoulder arthroplasty (11.7%) and 4 with hemiarthroplasty (1.2%). The mean EQ-5D was 0.88 (range 0.12-1) pre-trauma and 0.89 (range 0.1-1) 1y after trauma. The mean relative CS and SSV after 1 year were 99% (20-138) and 85% (20-100). The mean complication and re-operation rates were 19% and 13% respectively. 282 patients (84%) were treated according to the algorithm. The clinical outcome was significantly better if patients were treated according to the algorithm (CS 97% vs. 87%: p = 0.016; SSV 86% vs 79%: p=0.023) and re-operation rate was significantly lower (11% vs. 28%: p=0.001). Comparing V2 to V1, no significant clinical changes were found but the adherence to the algorithm was higher (89% vs. 83%, p=0.09) and the re-operation rate lower (11% vs. 15%, p=0.27).

Conclusion: After 4 years of prospective experience, we conclude that the use of a TA including patient specific factors is helpful to find the optimal individual treatment with successful clinical outcome and a low re-operation rate. The updated V2 enables a higher adherence and a lower re-operation rate.

FM15

Standardization of intraoperative 2D imaging of the elbow using nine reproducible projections - a cadaveric study. *(8339)*

Cornelia Baum[1]; PD Dr. Sebastian A. Müller[1]; Lars Adolfsson[2]; Magdalena Müller-Gerbl[1]; Prof. Dr. Daniel Rikli[1]

[1] University of Basel, Switzerland; [2] Linköping University, Sweden

Introduction: Two-dimensional fluoroscopy is considered the standard intraoperative imaging modality. Although it is widely used, important anatomical landmarks in complex anatomical regions like the elbow are often not uniformly defined. Malposition of implants or poor reduction may occur. The aim of this study was to define fluoroscopic standard projections of the elbow that cover the most important bony landmarks.

Methods: Cadaveric elbows were scanned under dynamic image intensification. Relevant bony landmarks were marked with wires. Ap, lateral, oblique and axial views were recorded for particular bony landmarks. The projections were then re-assessed with entire cadavers, which had been fixed in Thiel's solution in order to simulate the intraoperative setting. Projections showing defined bony landmarks were recorded to ensure reproducibility and to define standard projections.

Results: Two different ap, one lateral, four oblique and two axial views have been defined to display the most important anatomical landmarks of the elbow. These are the epicondyles, the trochlea, the capitellum, the olecranon, the greater sigmoid notch, the coronoid process and the proximal radio-ulnar joint.

Conclusion: A detailed knowledge about radiographic anatomy of the elbow is crucial for correct implant positioning and anatomic fracture reduction. Modern 3D imaging devices are helpful to identify these problems, but cannot replace 2D imaging, which is quicker and easier. The studied projections can visualize the most important anatomic landmarks of the elbow joint and should be used in clinical routine.

FM16

All suture no implant technique for fixation of unstable displaced distal clavicle fracture *(8346)*

Dr Gregory Cunningham[1]; Dr Morgan Gauthier[2]

[1] Shoulder Center, Hirslanden, Clinique la Colline, Geneva; [2] University Hospital Geneva

Introduction: Most distal clavicle fractures may be treated nonoperatively. However, in displaced type II and V fractures, surgery is recommended in active patients due to disrupted coraco-clavicular ligaments. However, distal fragment fixation remains a challenge, and no consensus has been established regarding the optimal treatment. Osteo-suture techniques have been popularized over the last decade, and multiple different techniques have been described. The aim of this study was to describe a novel all-suture technique in patients with displaced type II and V distal clavicle fractures and report its outcome in a prospective case series.

Methods: We prospectively followed up 11 patients with displaced acute distal clavicle fractures treated with an all-suture technique between 2017 and 2018, performed by one shoulder specialized surgeon, with a minimum follow-up of 1 year. The technique consisted in 4 strands around the coracoid and through the drilled clavicle, and 2 figure '8' and '0' sutures around the fracture site. Single assessment numerical evaluation (SANE) and Constant score were recorded at 6 months and 1 year. Radiologic union was assessed on plain radiograph.

Results: 9 males and 2 females were included in this study, with a mean age of 41.2 years (range, 21 to 61). There were 9 Neer type II and 2 Neer type V fractures. At 12 months, SANE was 97 and Constant score was 98. All patients achieved union, only one who developed a asymptomatic malunion, no other complication were noted.

Conclusion: Good outcome can be achieved with this all-suture fixation technique for displaced distal clavicle fracture with a high level of union. This technique present numerous advantages, including smaller exposure of the fracture site, avoids hardware-related complications such as screw fixation failure in small fragments, rotator cuff damage caused by hook-plates, and cost-effectiveness in terms of implant costs and avoiding a second operation for symptomatic hardware removal.

FM17

Stemless total shoulder arthroplasty with polyethylene nonspherical humeral head coupled with metal-backed anatomic metal glenoid. Preliminary experience. *(8349)*

Dr. Andreas Bischof[1]; Prof. Dr Andreas Niemeier; PD Dr Jens Agneskirchner; PD Dr Thilo Patzer; Dr Philipp Meyer; Dr Stefano Di Fabio; Dr Guido Zattoni; Dr Hans Rudolf Bloch

[1] Berit Klinik

Introduction. Prosthetic design can influence outcomes in TSA. A spherical humeral head articulating against a conventional non-conforming glenoid inlay may not reproduce the native shoulder kinematics and lead to changes in the biomechanics of rotator cuff tendons. A nonspherical humeral head articulating with a non-conforming anatomically-shaped glenoid inlay might improve the joint kinematics and reduce shoulder overstuffing, thus leading to better results. Aim of this multicenter study was to report the preliminary results of the first consecutive stemless total shoulder arthroplasties (TSA) with a new shoulder prosthesis with polyethylene nonspherical humeral head and metal-backed anatomic glenoid metal inlay.

Methods. 34 patients (34 shoulders), with an average age of 70 years (55-90) underwent uncemented stemless TSA with a new modular shoulder prosthesis with a polyethylene nonspherical humeral head coupled against a metal-backed anatomic glenoid metal inlay. Indication was primary glenohumeral osteoarthritis with intact rotator cuff, except 3 shoulders with partial cuff tear arthropathy (CTA) and no prior open shoulder surgeries. The study included 34 concentric glenoids. We retrospectively collected data including Constant Score (CS), visual analogue scale for pain (VAS), active range of motion, radiographic analysis and complications.

Results. After a mean follow-up of 15 months (range 9-24 months), all patients were completely satisfied referring a native joint perception at the operated side. Mean CS improved from 32 to 68 points. VAS decreased from 8 to 1. Mean active forward flexion significantly increased from 90° to 130°, abduction from 95° to 110°, external rotation from 35° to 50°. There were no cases of infection, periprosthetic fracture, component loosening or osteolysis. Complications included one posterior dislocation after 3 days which required conversion to a reverse TSA, one painful shoulder for CTA, one frozen shoulder and one humeral calcar impingement not related to the prosthesis.

Conclusion. TSA with nonspherical polyethylene humeral head coupled with metal-backed anatomic glenoid metal inlay revealed excellent preliminary results at this short-term follow-up. This new prosthetic design concept appears to be a suitable option for patients with glenohumeral osteoarthritis.

FM18

Management of distal bicep brachii tendon avulsion: A meta-analysis *(8366)*

Dr Marco Cuzzolin; Dr Davide Previtali; Dr Francesco Marbach; Dr Giuseppe Filardo; Dr Giuseppe Filardo; Prof. Dr Christian Candrian

EOC (Ente Ospadaliero Cantonale) - Ospedale Regionale di Lugano

Background: Distal bicep brachii tendon lesions affect 2.55 per 100,000 patients per year. Both conservative and surgical management are an option. However, there's not a clear objective evidence of which treatment entails in the best results.The aim of the current meta-analysis is to compare conservative versus the different options of a surgical management of distal bicep brachii tendon avulsions in order to assess possible benefits or harms of these different approaches.

Methods: A systematic literature search was performed on 10.02.2020 using PubMed, Web of Science, Cochrane library and Scopus literature databases. All human studies evaluating outcome of different surgical techniques and fixation device were included. Influence of the selected approach was assessed through-meta-analysis comparing surgical versus conservative treatment in terms of DASH and Mayo elbow scores, range of motion (ROM) and muscular strength. Sub-analysis regarding both the surgical technique and the fixation method used were performed. Risk of bias and quality of evidence were assessed following the Cochrane guidelines.

Results: Fifty-three out of 844 studies matched the inclusion criteria. The results of the meta-analysis denoted significant differences in favour of the surgical approach in terms of DASH score ($p=0.002$), Mayo Elbow score ($p <0.001$), flexion ($p <0.001$) and supination strength ($p <0.001$). No significant difference was found for flexion and extension ROM. In the sub-analysis comparing single and double incisions approaches for bicep fixation, the first had significantly better postoperative pronation ROM ($p=0.01$), while all other outcomes did not reach statistical significance. In the sub-analysis comparing 3 different kind of fixation method, patient whom biceps were fixed using a suture anchor were found once again to have better pronation ROM ($p=0.03$), while all other outcomes did not statistically differ.

Conclusions: Surgical treatment provides better outcomes at follow-up compared to the conservative approach. In addition, similar results were found for the different surgical technique and fixation method with an advantage underlined only for pronation ROM. However the lack of high quality trials suggests the need for further, properly conducted research to determine the best treatment for distal bicep tendon avulsion.

FM19

Reverse Shoulder Arthroplasty in Patients who Exceeded the Estimated Life-Expectancy *(8384)*

Dr. Mai Lan Dao Trong[1]; Dr. Michèle Kläusler[1]; Dr. Dimitris Dimitriou[1]; Michael Grabherr[1]; Sören Möller[2]; PD Dr. Näder Helmy[1]; Dr. Ulf Riede[1]

[1] Bürgerspital Solothurn; [2] Kantonsspital St. Gallen

Introduction: Reverse shoulder arthroplasty (RSA) has become an established treatment for cuff arthropathy and severe osteoarthritis as well as in certain fracture cases for elderly patients. Patients older than 80 years pose a significant challenge to both the anesthesiologist and the shoulder surgeon. Due to the increasingly aging population, the purpose of this study was to report the clinical outcomes, complication rate, mortality and quality-adjusted-life-year (QALY) for reverse shoulder arthroplasty in patients who already exceeded the average life-expectancy.

Methods: Patients treated with reverse shoulder arthroplasty who already exceeded the average life-expectancy in Switzerland (n=95) were included. Elective (n=40) and fracture (n=55) cases were compared. Demographics, complication rate, functional outcome scores, range of motion (ROM) and QALY were assessed retrospectively.

Results: The average age at time of surgery was 86.4±3.4 years (p = 0.5). The 30-days and 1-year mortality was both 6% in the elective group and 12% and 18% respectively in the fracture group. The complication rate requiring surgical intervention was 3% in the elective group and 2% in the fracture group. Elective cases showed a significant shorter hospital stay length compared to fracture cases (p <0.01). Mean time of follow-up was 30 months. Functional outcome scores showed significantly better results for the elective group with ASES 79±19 vs. 61±21, SSV 86±14 vs. 70±26, VAS 0.5±1.3 vs. 2.8±2.1 and QuickDASH 29±16 vs. 45.8±11 (p <0.05). There was no significant difference in ROM and mean QALY (3.5 years) between both groups.

Conclusion: RSA in patients who already exceeded the average life expectancy can be successful with good functional outcomes. Age should not be a contraindication. Instead, the patient's activity level and quality of life should be taken into account. Nevertheless, elective RSA show better functional outcome scores and lower complication rates compared to RSA in proximal humeral fractures for very old patients.

FM20

Acne Crème (Benzoyl Peroxide and Miconazole Nitrate) Reduces Deep Cutibacterium Acnes Tissue Load before Elective Open Shoulder Surgery - a Randomized-Controlled Trial *(8398)*

Dr. Ines Unterfrauner; PD Dr. Karl Wieser; Dr. Silvan Beeler; Sabrina Catanzaro; PD Dr. Ilker Uçkay; PD Dr. Samy Bouaicha

Balgrist University Hospital

Introduction: Cutibacterium (formerly Propionibacterium) acnes is the main pathogen of acne and of surgical site infections (SSI) in the shoulder. In acne therapy, the Benzoyl Peroxide and Miconazole Nitrate cream effectively reduces the superficial C. acnes burden in the skin. Its additional potential for subcutaneous layers (e.g. for future SSI prevention) is unknown.

Methods: We perform a prospective-randomized trial (1: 1), allocating adult elective shoulder patients between a minimum 7-days-preoperative skin application of a Swissmedic-approved acne crème (Benzoyl Peroxide and Miconazole Nitrate once a day at standard dose) versus no crème. We display the last interim results. One week before surgery, we perform a superficial microbiological skin sample, and repeat it intraoperatively also in subcutaneous and capsular tissues (3 samples). All cultures are incubated for 14 days. The crème roughly costs CHF 10 for a week. The antibiotic prophylaxis remains unchanged (Cefuroxime tid for 24h).

Results: At the last interim analysis in February 2020, we assessed 53 patients (mean age 58 years, range 18-86 y, 53% females) with primary open shoulder surgery (16 Latarjet procedures, 37 shoulder arthroplasties). Among them, 28 received the acne crème and 25 did not. At baseline, both groups revealed C. acnes skin carriage to 60% (17/28 in the intervention group; 15/25 in controls). The acne crème resulted in a significant reduction of the numbers of positive intraoperative cultures in patients with known C. acnes skin colonization compared to the controls (10/17 vs. 3/15; p=0.03). One patient showed an allergic reaction to the acne crème with redness and itching of the skin. We detected no postoperative wound complications or SSIs in either group. The study and the active follow-up still continue for another month.

Conclusion: In this interim analysis, the topical 7 day-preoperative skin application of Benzoyl Peroxide and Miconazole Nitrate was well tolerated and significantly reduced the presurgical superficial and deep C. acnes burden in at least 50% of the episodes. Quantitative microbiological analyses and clinical consequences (or follow-up studies) will be elucidated after study completion.

FM21

Influence of Parkinson's disease on outcome and complication rate of reverse total shoulder arthroplasty – a matched group analysis *(8408)*

Dr. Paul Borbas; Dr. Philipp Kriechling; PD Dr. Samy Bouaicha; PD Dr. Karl Wieser

Universitätsklinik Balgrist

Parkinson's disease (PD) is associated with a higher complication rate after common orthopaedic procedures, such as spinal fusion, knee and hip arthroplasty. Few reports have also suggested higher complication rates after reverse total shoulder arthroplasty (RTSA). The aim of this study was to assess the outcome and the risk for complications in patients with RTSA.

A total of 17 patients (mean age 73.9 years) with diagnosed PD and RTSA with a minimum follow-up of 2 years were identified at the authors' institution database of RTSAs. These patients were compared with a matched cohort group of 41 patients (mean age 73.8 years) without PD. Complications and revisions for all patients were found through review of medical and surgical records. The outcomes scores included the Constant score and the subjective shoulder value.

The mean absolute Constant score in the PD group improved from 33 (SD 18) to 48 (SD 18) points (p = 0.009); the mean absolute Constant score improved from 28 (SD 20) to 66 (SD 16) points in the matched control group (p <0.0001). The postoperative constant score at an average follow-up of 48 months (SD 17) was significantly higher in the control group (p <0.0001) compared to patients with PD. The mean subjective shoulder value was also statistically significantly higher in the matched control group (48 vs. 66%; p <0.001). Postoperative complications (7% vs. 35%; p <0.001) and reinterventions (0% vs. 29%; p <0.0001) were substantially higher in patients with PD, with acromion fractures as the most frequent complication.

RTSA in patients with PD is associated with a significantly higher complication and revision rate as well as worse clinical outcome. Indication for RTSA should be carefully evaluated and questioned in this patient population.

FM22

Acromioclavicular joint stabilization with a double cow-hitch technique compared to a double Tight-Rope: a biomechanical study *(8409)*

Dr. Paul Borbas[1]; Daniele Angelella; Elias Bachmann[2]; Dr. Lukas Ernstbrunner[1]; PD Dr. Samy Bouaicha[1]; PD Dr. Karl Wieser[1]

[1] Universitätsklinik Balgrist; [2] Universitätsklinik Balgrist / Institute for Biomechanics, ETH Zurich

The aim of the present biomechanical study was to evaluate the stability of a novel simple and cost-effective technique of acromioclavicular (AC) joint stabilization in comparison to a well-established technique with a double Tight-Rope.

A total of 12 fresh-frozen cadaveric shoulders were randomized into 2 treatment groups. In either a coracoclavicular (CC) stabilization with a double cow-hitch with two No.5 FiberWire strains looped in a bicortical button placed at the bottom of the coracoid process (Group 1), or a standard double Tight-Rope technique (Group 2). Both techniques were equally augmented with an AC joint cerclage with a FiberTape. All shoulders were tested in a servo-hydraulic material testing machine for elongation (in mm) after cyclic loading (70 N cyclical load, 1500 cycles), stiffness (N/mm) and ultimate load to failure (N). The mechanism of failure was recorded. All tests were performed in a previously published test-set-up.

After 1500 cycles, group 1 showed an elongation of 1.67 mm (SD 0.85), compared to 1.04 mm (SD 0.23) cyclic displacement in group 2 (p = 0.12). The cyclic displacement after AC reconstruction in group 2 was even 0.36 mm lower than in the native state with intact ligaments, whereas the cyclic elongation in group 1 was 0.05 mm higher compared to the native situation. Ultimate load to failure and stiffness were both higher in group 1 with 424 N (SD 97) and 68.6 N/mm (SD 8.2), compared to 377 N (SD 62) and 67.7 N/mm (SD 13.2) in group 2, respectively (p = 0.69 and 0.89).

Stabilization of the AC joint with a novel double cow-hitch technique resulted in a similar low elongation, high stiffness and ultimate load to failure compared to a double Tight-Rope technique. The double cow-hitch technique is a novel cost-effective technique for AC joint stabilization and could demonstrate a sufficient biomechanical stability with especially high stiffness and load-to-failure.

FM23

No difference in outcome for open versus arthroscopic rotator cuff repair in long-term: A prospective randomized study *(8411)*

Dr. Anita Hasler[1]; Dr. Silvan Beeler; Dr. Tobias Götschi; Sabrina Catanzaro; Prof. Dr. Christian Gerber

[1] *Universitätsklinik Balgrist*

Background: Currently arthroscopic techniques are preferred to open repairs of the rotator cuff. Short- and midterm studies have shown comparable outcomes, with no clear superiority of either technique. The aim of this study was to compare the long-term clinical outcomes and cuff integrity following arthroscopic or open rotator cuff repair.

Method: 40 patients were prospectively randomized to undergo arthroscopic or open rotator cuff repair. Clinical and radiographical follow-up was performed at 6 weeks, 3 months, 1 year, 2 years and >10 years postoperatively. Clinical assessment included the measurement of range of motion, Visual Analogue Scoring (VAS) for pain, scoring according to Constant and Murley (CS) and assessment of the Subjective Shoulder Value (SSV). Imaging included conventional radiography and MRI for the assessment of cuff integrity and alterations to the deltoid muscle.

Results: 20 patients with a mean age of 60 years (range, 50-71, SD ±6 years) had been allocated to the arthroscopic and 20 patients with a mean age of 55 years (range, 39-67, SD±8 years) to open surgery. Longer than 10 years of follow-up was available for 13 patients of the arthroscopic and 11 patients of the open surgery group, with a mean follow-up of 13.8 years (range, 11.9-15.2, SD ±1.1years) and 13.1 years (range 11.7-15, SD±1.1years) respectively. No statistically significant differences in clinical outcome were identified between the two groups, with a median absolute CS of 79 points (range, 14-84 points) in the arthroscopic surgery group vs 84 points in the open surgery group (range, 56-90 points), p= .177: and a median relative CS of 94% (range, 20-99%) and 96% respectively (range, 65-111%,), p=.429. Median SSV was 93% (range, 20-100%) in the arthroscopic surgery group and 93% (range, 10-100%) in the open surgery group, p= .976. MRI evaluation showed a retear rate of 30% with an equal contribution from both two groups. Neither fatty infiltration of the deltoid muscle, deltoid muscle volume, nor the attenuation the deltoid origin was different between the two groups.

Conclusions: We could not show any difference in clinical and radiographic outcome at long-term follow up between arthroscopic and open rotator cuff repair. The suspicion that early arthroscopic techniques lead to less stable cuff reinsertion and the postulated harm to the deltoid muscle with the open technique could both be refuted.

FM24

Joint-Line Medialization following anatomical total shoulder replacement requires more rotator cuff activity to preserve joint stability *(8413)*

Dr. Anita Hasler[1]; Dr. Elias Bachmann; Dr. Andrew Ker; Dr. Arndt Viehöfer; PD Dr. Karl Wieser; Prof. Dr. Christian Gerber

[1] *Universitätsklinik Balgrist*

Introduction: The management of glenoid bone loss in total shoulder arthroplasty (TSA) can lead to medialization of the joint line. The aim of this study was to investigate whether medialization of the joint line and thus the center of rotation, leads to higher forces needed from the rotator cuff or deltoid muscles for stabilizing the arm in space.

Methods: A computational rigid body model of the shoulder with an implanted anatomical total shoulder replacement was designed. Simulations using this model then allowed to evaluate the joint instability ratio and the rotator cuff and deltoid muscle forces needed to stabilize the arm during elevation in function of the medial to lateral position of the joint line. Muscle forces and the instability ratio were first determined with a native joint line position, then with the joint line medialized and lateralized by either 2 or 6 mm.

Results: Higher deltoid muscle force was required throughout the whole course of glenohumeral joint elevation when the joint line was medialized, lower force if the joint line was lateralized with highest values for the 6mm displacement. When assessing the rotator cuff muscles, medialization resulted in higher forces needed in the early phase of elevation (between 30-42 degrees) compared to the native joint line position. Lateralization of the joint line led to higher muscle forces generated by the rotator cuff above 52°of elevation and to higher absolute values in muscle activity. A maximum instability ratio was recorded when medializing the joint line by 6mm, with a ratio of >0.6.

Conclusion: The data from this biomechanical computer model supports the theory that by restoring the native joint line whilst performing an anatomical TSA, lower forces are required for the deltoid muscle to elevate the arm, compared to medializing the joint line. Furthermore, the shear force generated by the deltoid causing superior instability of the joint was also reduced by restoring the joint line; and lower forces were generated by the rotator cuff in the early phase of elevation, compared to a medialized position. This suggests that restoring the joint line is relevant for as well cuff and deltoid load and function.

FM25

La désinfection du tissu sous-cutané diminue la contamination du champ opératoire par P. acnes lors d'une chirurgie primaire de l'épaule *(8426)*

Dr Nicolas Gallusser[1]; Dr Stéphane Emonet; Prof. Dr Nicolas Troillet; Bertrand Leger; PD Dr Beat Kaspar Moor

[1] *Hôpital du Valais*

Introduction: Cutibacterium acnes is one of the major pathogens responsible for infection after shoulder surgery. Surgical dissection of the dermis may expose C. acnes from sebum-producing hair follicles. Due to contact with surgeon's gloves and instruments these are further spread throughout the surgical field. The purpose of this study was to determine if subcutaneous tissue disinfection could reduce the C. acnes culture rate during primary shoulder surgery.

Methods: All patients eligible for primary open shoulder surgery using a deltopectoral approach were prospectively enrolled in our 2-arm randomized, single blinded clinical trial. In all patients a skin swab of the operative field was taken prior to standard surgical skin preparation. After exposure of the deltoid fascia, the disinfection group received an additional preparation of the subcutaneous layer with povidone-iodine solution. Before performing the arthrotomy or the reduction maneuver during osteosynthesis, 5 swabs from different sites were taken for microbiological examination according to a strict specimen collection protocol. All cultures were incubated in aerobic and anaerobic conditions for 14 days.

Results: Between February 2019 and December 2019, 108 patients were enrolled in two groups (70 treatment vs 38 control). The two groups did not show any significant difference in terms of gender, age, BMI or occurrence of diabetes. The subcutaneous disinfection protocol reduced significantly the positive culture rate of the operating field for all germs combined (p = 0.03) and specifically for C. acnes (p = 0.01). The reduction of positive swabs for C. acnes was significantly for the surgeon's gloves (p = 0.017) as well as for the retractors (p = 0.004).

Conclusion: Disinfection of the subcutaneous tissue significantly reduces the C. acnes culture rate during primary shoulder surgery. We highly recommend to add this simple step to the current surgical practice in order to limit iatrogenic contamination of the surgical field. Future studies may observe a reduction in postoperative shoulder infection due to this practice.

FM26

Impact of sports activity on clinical and radiological outcomes 5 years after implantation of reverse shoulder arthroplasty in defect arthropathy *(8431)*

David Endell[1]; Alexandra Grob[2]; Dr. Hans-Kaspar Schwyzer[1]; Dr. Michael Glanzmann[1]; Prof. Dr. Laurent Audigé[2]; Prof. Dr. Markus Scheibel[1]

[1] Schulthess Klinik Zürich; [2] Research and Development Department, Shoulder and Elbow Surgery, Schulthess Clinic, Zürich, Switzerland

Introduction: The objective of this study is to identify a possible link between participation in sports or physical activity of the upper extremity in patients who underwent reverse shoulder arthroplasty surgery. Clinical and radiological parameters after 5 years follow up were compared between three collectives who participated regularly in sport of the upper extremity (SUE), lower extremities (SLE) or did not participate in sports respectively (NS).

Methods: A questionnaire addressing the type and level of sports activity for patients with primary reverse shoulder arthroplasty had been implemented. In this cohort-study 138 patients were divided into three collectives (n=43 in SUE, n=27 in SLE und n=68 in NS) and matched concerning age, sex and endoprosthesis type (135° and 155° inclination). Radiological parameters were analyzed for loosing and notching according to the international core-set. Additionally the following clinical scores were evaluated: SSV, CS, SPADI and QuickDASH.

Results: The three collectives showed similar distributions in age, sex and endoprosthesis type. The baseline value of the clinical scores showed no difference, except for a better baseline value of the SUE collective in the CS of 41.1 points compared to 28.9 (SLE) and 33.0 (NS). All collectives showed improvement in the clinical scores at 5 years. The SUE collective showed significant better end results with a mean CS of 76.1 compared to 69.4 (SLE) and 66.3 (NS) (p=0,005). The SUE collective also showed significantly better end results in the SPADI (89.9 compared to 76.5 und 77.5 points, p=0.002) and in the QuickDASH (15.2 compared to 27.6 and 29.4 points, p=0.003). The absolute change of the clinical scores at follow-up compared to the baseline showed no sign. difference in between the three collectives (CS p=0.359, SPADI p=0.633, QuickDASH p=0.257). The radiological follow-up showed comparable results for humeral loosening rates of the diaphysis region in between the SLE (11%) and NS (9%) collective, with a significant difference (p=0.045) to SUE (2%). Notching was observed in 41% (SUE) to 37% (SLE) and 52% (NS), with no sign. difference (p=0.417).

Conclusion: The participation in sports activities of the upper extremity after implantation of reverse shoulder arthroplasty revealed excellent clinical results in the comparison between the collectives after a medium-term follow-up. Higher loosening rates are not to be suspected despite physical activity.

FM27

Long-term results of non-operative treatment of anterior glenoid rim fractures after first-time traumatic anterior shoulder dislocation *(8433)*

Dr. Lukas Ernstbrunner[1]; Dr. Manuel Waltenspül[1]; Dr. Arend Nieuwland[1]; Dr. Elias Ammann[2]; PD Dr. Karim Eid[2]; Prof. Dr. Christian Gerber; PD Dr. Karl Wieser[1]

[1] Universitätsklinik Balgrist; [2] Kantonsspital Baden

Fragestellung: Die optimale Therapie nach vorderer Glenoidrandfraktur ist umstritten, wobei die operative Versorgung trotz fehlender Evidenz oft bevorzugt wird. Als Gründe gegen eine konservative Therapie werden das Risiko für Reluxationen sowie posttraumatische Omarthrose genannt. Ziel dieser Studie war es, die Rezidivrate bzw. das Omarthroserisiko nach konservativer Therapie einer vorderen Glenoidrandfraktur im Langzeitverlauf zu untersuchen.

Methodik: Im Rahmen einer Multizenterstudie wurden alle Patienten die nach Erstluxation im CT eine isolierte, vordere Glenoidrandfraktur mit zentriertem Humeruskopf zeigten, eingeschlossen. Die betroffene Schulter wurde in einer Schlinge oder Orthese für 4 Wochen nachbehandelt, Pendulumbewegungen waren erlaubt. Insgesamt wurden 28 Patienten mit einem mittleren Alter von 48 (Range, 29-67) Jahren zum Zeitpunkt des Traumas und einem mittleren Nachuntersuchungszeitraum von 9 (5-14) Jahren klinisch radiologisch (inkl. CT) nachkontrolliert.

Ergebnis: Ein Patient (4%) erhielt bei sekundärer Omarthrose bei persistierender Instabilität 9 Jahre posttraumatisch eine Hemiprothese, dieser Patient wurde aus der weiteren Analyse ausgeschlossen (relativer Constant Score (CS) 101%, subjektiver Schulterwert (SSV) 90%). Zum Zeitpunkt der Nachuntersuchung hatte ansonsten kein Patient eine Rezidivinstabilität (Luxation oder Subluxation) oder ein positives Apprehension-Zeichen. Bei 2 Patienten (7%) zeigte sich eine neuaufgetretene, asymptomatische Arthrose (je einmal Grad I & III nach Samilson), wobei keiner dieser Patienten Beschwerden angab (Constant Schmerzskala, 15 Pkt.) und eine sehr gute Schulterfunktion vorwiesen (CS%, 69-106%). Bei allen Patienten war die Konsolidation des Fragmentes computertomographisch nachzuweisen. Insgesamt bewerteten 25 Patienten (93%) die Funktion ihrer Schulter als gut oder sehr gut, 2 (7%) als mässig. Der mittlere relative CS, ASES und WOSI-Score betrug 98% (61-108%), 3 (0-24) und 104 (0-660) Punkte.

Schlussfolgerung: Die konservative Therapie von vorderen Glenoidrandfrakturen nach vorderer Schulterluxation führt auch im Langzeitverlauf zu klinisch hervorragenden Ergebnissen mit einer äusserst geringen Rate an Rezidivluxationen oder posttraumatischer Omarthrosen. Die operative Therapie bleibt deshalb weiterhin Patienten mit dezentriertem Humeruskopf oder persistierender Instabilität vorbehalten.

FM28

Joint fluid aspiration performance of different flexible catheters compared with standard punction needles in shoulder cadavers *(8461)*

Dr. Andreas Hecker[1]; Dr. Manuel Waltenspül[1]; Dr. Lukas Ernstbrunner[1]; PD Dr. Reto Sutter[2]; PD Dr. Karl Wieser[1]; PD Dr. Samy Bouaicha[1]

[1] Department of Orthopeadic Surgery, Balgrist University Hospital; [2] Department of Radiology, Balgrist University Hospital

Introduction: Arthrocentesis of the shoulder joint is not well studied yet. A recent study reports a sensitivity of only 33% while the literature provides a big range between 16.7% and 81.3%. The rate of dry aspirations is about 43%. In our experience a radiologically controlled anterior approach in supine position is the most effective way to perform shoulder aspirations in a high volume center. The aim of this study is to outline the technical problems of shoulder joint aspirations and to propose a possible solution that maximizes the amount of the obtained fluid and might reduce the rate of dry aspirations.

Methods: Ten cadaver shoulder joints were filled with one, five, ten, twenty and thirty milliliters of contrast agent. For each filling status 4 shoulder aspiration devices (20 gauge needle, 16 gauge needle, 16 gauge catheter and 16 gauge perforated catheter) were compared. All aspirations were done in supine position from anterior under fluoroscopic control.

Results: The aspirated amount of fluid was significantly higher using the 16 gauge perforated catheter compared with the standard 20 gauge needle when one millilitre contrast agent was in the joint. With five, ten and twenty millilitres filling the modified 16 gauge catheter showed significantly higher values compared with all other devices. Regarding 30 ml of filling the perforated catheter was significantly superior to the 16 gauge catheter and needle but not to the standard 20 gauge needle.

Conclusion: A perforated flexible catheter is a desirable option for shoulder aspirations. Using such a catheter leads to a 27-100% higher amount of aspirated fluid and could therefore increase the sensitivity of shoulder aspirations. Also the rate of dry aspirations might be reduced in the clinical setting. Considering a rising number of shoulder revision surgeries the need to increase the sensitivity of shoulder aspirations is obvious. Therefore we plan to manufacture a catheter like the prototype described in this study and bring it to the level of clinical evaluation.

FM29

Deltoid muscle contribution to shoulder flexion and abduction strength – An experimental approach *(8462)*

Dr. Andreas Hecker[1]; PD Dr. José Aguirre[2]; Prof. Dr. Urs Eichenberger[2]; Dr. Jan Rosner[3]; PD Dr. Martin Schubert[3]; PD Dr. Reto Sutter[4]; PD Dr. Karl Wieser[1]; PD Dr. Samy Bouaicha[1]

[1] Department of Orthopeadic Surgery, Balgrist University Hospital; [2] Department of Anesthesiology, Balgrist University Hospital; [3] Spinal Cord Injury Center, Balgrist University Hospital; [4] Department of Radiology, Balgrist University Hospital

Introduction: The rotator cuff (RC) and the deltoid muscle are two synergistic units that enable the functionally demanding movements of the shoulder. A number of biomechanical studies assume similar force contribution of the force couple (RC and deltoid) over the whole range of motion, while others propose position dependent force distribution. There is a lack of in vivo data regarding the deltoid`s contribution to shoulder flexion and abduction strength. The aim of this study is to create reliable in vivo data, quantifying deltoid`s contribution to shoulder flexion and abduction strength throughout range of motion.

Methods: Active range of motion and isometric muscle strength of shoulder abduction and flexion in 0, 30, 60, 90 and 120 degrees of abduction/flexion as well as internal and external rotation in 0 and 90 degrees of abduction were obtained in 12 healthy volunteers on the dominant arm before and after an ultrasound-guided isolated axillary nerve block. Needle electromyography was performed before and after the block to confirm deltoid paralysis. Radiographs of the shoulder and an ultrasound examination were used to exclude relevant shoulder pathologies.

Results: Active range of motion showed a moderate reduction to 94% and 88% of the pre-intervention value for abduction and flexion. Internal and external rotation amplitude was not impaired. The abduction strength was significantly reduced to 76% at 0° and to 25% at 120° of abduction. The flexion strength was significantly reduced to 64% at 30° and to 30% at 120° of flexion. The strength reduction was linear, depending on the flexion/abduction angle. The maximal external rotation strength showed a significant decrease to 53% in 90° of abduction, while in adduction no strength loss was observed. The internal rotation strength remained unaffected in 0 and 90° of abduction.

Conclusion: The deltoid shows a linear contribution to maximal shoulder strength depending on the abduction or flexion angle, ranging from 24% in 0° to 75% in 120° of abduction and from 11% in 0° to 70% in 120° of flexion, respectively. The combination of deltoid muscle and teres minor contributes about 50% to external rotation strength in 90° of abduction. The internal rotation strength is not influenced by a deltoid paralysis. This study highlights the position-dependent contribution of the shoulder muscles to strength development and thereby provides a novel empirical approach to better understand human shoulder kinematics.

FM30

PARP-Inhibitor Talazoparib inhibits Muscle Atrophy and Fatty Infiltration in a Tendon Release Infraspinatus Sheep Model *(8471)*

Dr. Maurits G. L. Olthof; Dr. Anita Hasler; Prof. Dr. Christian Gerber; Karina Klein; Brigitte von Rechenberg; PD Dr. Karl Wieser

Balgrist University Hospital

Background: Structural muscle changes, including muscle atrophy and fatty infiltration, are associated with poor outcome of rotator cuff repair. Despite extensive research efforts, no pharmacological therapy is available that inhibits both muscle atrophy and fatty infiltration. PARPs are identified as a key transcription factors involved in maintenance of cellular homeostasis. As these factors are associated with several intracellular pathways that influence muscle degeneration, including mitochondrial hemostasis, oxidative stress, inflammation and metabolic activity, we hypothesized that PARP-inhibition reduces muscle degeneration.

Materials and methods: Tenotomized infraspinatus muscles were assessed for muscle degeneration during 16 weeks using a Swiss Alpine sheep model (n = 6). All sheep received daily oral administration of 0.5 mg Talazoparib. Considering the three Rs principles in animal research ethics, the treatment group was compared with a control from a prior study of our institution. The control sheep (n = 6) were treated with an identical study protocol without Talazoparib treatment. Muscle atrophy and fatty infiltration were evaluated at 0, 6 and 16 weeks post-tenotomy using DIXON-MRI.

Results: Although both the treatment group and the control showed a significant ($p < 0.01$) decrease of muscle volume after 6 weeks, the treatment group showed significantly ($p = 0.03$) less atrophy compared to the control (91 ± 5% and 77 ±% 9 of the original volume at t = 0, respectively). A similar effect was seen after 16 weeks with significantly ($p = 0.01$) less atrophy in the Talazoparib group compared with the control (93 ± 11% and 76 ± 10%, respectively). Furthermore, whereas Talozoparib treatment showed significantly ($p = 0.01$) more fatty infiltration compared to the control group after 6 weeks (21 ± 5% and 14 ± 5%, respectively), Talazoparib generated significantly ($p = 0.01$) less fatty infiltration compared to the control group after 16 weeks (34 ± 8% and 49 ± 5%, respectively).

Conclusion: This study shows that PARP-inhibition with Talazoparib inhibits both muscle atrophy and fatty infiltration after tenotomy. Ongoing histological and biochemical analysis might give insights to further optimize its efficacy.

FM31

Mid-term clinical and radiographic outcome of salvage iliac crest bone grafting for the failed Latarjet procedure *(8485)*

Dr. Lukas Ernstbrunner[1]; Dr. Torsten Pastor; PD Dr. Samy Bouaicha[1]; Prof. Dr. Christian Gerber[1]; PD Dr. Karl Wieser[1]

[1] Balgrist

Introduction: Patients with recurrent anterior shoulder instability after failed Latarjet-stabilization are surgically challenging due to severe bone loss, graft resorption, potentially displaced or broken screws and changed anatomy after coracoid transfer. The aim of this study was to analyze medium-term results of a salvage procedure using an iliac crest bone graft (ICBG) after failed Latarjet procedure.

Methods: Twenty consecutive patients after a failed Latarjet procedure were revised using an ICBG. Sixteen patients (80%) with a mean age of 33 (range, 25-55) years at time of surgery were re-examined clinically and radiographically (incl. CT) after a mean follow-up of 5 (range, 2-8) years.

Results: All included patients had recurrent instability after the Latarjet procedure, 12 redislocated (75%) and 4 had recurrent subluxations (25%). After revision with an ICBG, 7 patients (44%) experienced recurrent dislocations. In 5 of these patients the bone block showed moderate resorption but none of these patients showed a non-union of the bone block. Five (31%) patients had to be revised: 2 patients received an arthrodesis; 1 a reverse total shoulder arthroplasty; 1 another (anterosuperior) glenoid augmentation using a contralateral ICBG; and 1 an allograft reconstruction of a large Hill Sachs lesion with combined open Bankart repair. The remaining 11 patients remained stable with an uncomplicated follow-up. These patients were all (very) satisfied with the postoperative outcome and had a mean WOSI score of 760 ±306 points and a subjective shoulder value of 86% ±10. The subscapularis remained clinically (tested by lift-off test) and radiographically (CT: Goutallier grade 0: n=8; grade 1: n=7; grade 2: n=1) intact in all but one patient. The bone block showed little or no resorption in 10 out of 16 patients (62%). Six bone blocks (38%) were moderately resorbed, 5 of which were associated with recurrent instability ($p=0.024$). The mean dislocation arthropathy showed no significant progression compared to the preoperative state (0.5; range, 0-2 vs. 0.7; range, 0-3; $p=0.083$).

Conclusion: Salvage iliac crest bone grafting for the failed Latarjet procedure showed a high failure rate of more than 40% due to persistent instability which was significantly associated with an at least partially resorbed iliac crest bone graft. Patients with a stable shoulder showed excellent clinical and radiographic outcomes with high satisfaction and no to minimal bone block resorption.

FM32

Results after revision arthroscopic rotator cuff repair - a prospective multi-center study on 100 cases *(8492)*

Dr. Eduard Buess[1]; PD Dr. Michael Hackl[2]

[1] Praxis Shouldercare; [2] Klinik für Orthopädie und Unfallchirurgie Universitätsklinikum Köln

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±18% preoperatively to 66±24% at six months to 75±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.

FM33

Biomechanics of posterior glenoid bone block procedures for posterior instability with and without correction of glenoid retroversion *(8530)*

Dr. Lukas Ernstbrunner[1]; Dr. Rafael Loucas[1]; Dr. Andrew Ker[1]; Dr. Paul Borbas[1]; PD Dr. Florian Imhoff[1]; Simon Hofstede; PD Dr. Karl Wieser; PD Dr. Samy Bouaicha

[1] Department of Orthopedics, Balgrist University Hospital, University of Zurich

Objective: Posterior shoulder instability (PSI) in patients with pathologic glenoid retroversion and dysplasia is still an unsolved problem in shoulder surgery. The aim of this study was to investigate biomechanical stability of bone block procedures for posterior instability with and without correction of glenoid retroversion.

Methods: A total of 6 freshly-frozen human cadaveric shoulders were investigated for this study. The glenoid was aligned parallel to the floor. The capsule was kept intact and the humerus was fixed at 60° of glenohumeral anteversion and neutral rotation. Glenoid retroversion was created by posterior wedge resection. Three specimens underwent a posterior bone block stabilization without correction of glenoid retroversion (group bone block (BB)). The second group of three specimen received a posterior bone block stabilization using an implant-free, J-shaped iliac crest bone graft, with correction of glenoid retroversion to 0° (group J-graft (JG)). Glenoid version was tested from 0° to -20° retroversion by 10° increments. After cyclic preloading, a peak translation force (N) for posterior humeral head translation over a predefined length (25% of glenoid width) was measured with MicroScribe digitizer. The peak translational force for posterior humeral head translation was compared between intact vs. 0° in the JG group vs. 0°, -10° and -20° in the BB group. A higher translational force for posterior humeral head translation was considered as higher stability.

Results: Peak translational force was identical after correction of -20° of glenoid retroversion in the 0° JG group compared with the intact condition. There was no significant difference between the -10° BB group and the 0° JG group (25.8N vs. 25N; p=0,1304). However, peak translational forces were significantly lower at -20° in the BB group compared with the 0° JG group (14N vs. 25N; p=0.042).

Conclusion: This biomechanical study shows that the correction of glenoid retroversion using an implant-free, J-shaped iliac crest bone graft can restore bony stability in glenoids with -20° of retroversion comparable to an intact condition. At -10° of retroversion, there is no significant difference between the two groups. However, at -20° of retroversion, the corrective posterior J-graft procedure showed significantly higher stability compared to the isolated posterior bone block stabilization without correction of glenoid retroversion.

FM34

Long-term results after arthroscopic reconstruction of anteroinferior glenoid rim fractures *(8562)*

Nina Maziak[1]; Andreas Keck[1]; Marvin Minkus[1]; Prof. Dr. Markus Scheibel[2]

[1] Charité - Universitätsmedizin Berlin; [2] Schulthess Clinic

Introduction: The optimal treatment of anteroinferior glenoid rim fractures is still a matter of debate. The aim of the present study was to evaluate clinical and radiographic long-term results of patients who underwent arthroscopic reconstruction using anchors or bioabsorbable compression screws.

Methods: Clinical outcome was assessed using the Subjective Shoulder Value (SSV), Constant Score (CS), Rowe Score (RS), Western Ontario Shoulder Instability Score (WOSI) and Melbourne Instability Shoulder Score (MISS). True anterior-posterior, axillary and Bernageau views were obtained for radiographic evaluation.

Results: Nineteen patients (13 men, 6 women, Ø61 years) after arthroscopic reconstruction of an acute large solitary or multifragmented anteroinferior glenoid rim fracture were included in this retrospective study. After a mean (± SD) follow-up of 10±2 years, patients reached a mean SSV of 92±12%. The average CS was 90±11 points, the RS was 86±15 points. The mean WOSI averaged 98%±2% and the mean MISS was 88±11 points. No patient had suffered a recurrent dislocation. Radiographic results were obtained of sixteen patients. Signs of osteoarthritis were noted in a total of six patients. Worse clinical results were noted for the WOSI and RS in patients with osteoarthritis. These differences, however, were non-significant.

Conclusion: Arthroscopic reconstruction of acute large solitary and multifragmented fractures of the glenoid rim shows good clinical long-term results. Osteoarthritis can be observed in about one-third of all patients and seems to be associated with slightly worse clinical outcomes.

FM35-FM41: HAND

FM35

Complex distal radius fracture in the elderly treated by wrist hemiarthroplasty *(8153)*

Dr Cindy Bouvet; Prof. Jean-Yves Beaulieu

HUG Hôpitaux-Universitaires-Genève

Introduction: Distal radius hemi-arthroplasty is a surgical option not widely used in the management of comminuted fractures of the distal radius in elderly patients. In these cases, open reduction and internal fixation results in frequent complications and secondary displacement, particularly due to poor bone quality. The aim of this study was to report the short- and mid-term results of distal radius hemi-arthroplasties in C3 distal radius fractures in elderly patients.

Material and methods: From July 2016 to May 2019, 17 patients, mean aged of 79 years (68-89), were treated with a cemented radial hemiarthroplasty ; in 16 cases with a REMOTION prosthesis (SBI) and in one case with a SOPHIATM prosthesis (Biotech). Ulnar distal resection (Darrach procedure) was done at the same time in 14 patients. Clinical, functional and radiographic assessments were performed. Per and postoperative complications were noticed.

Results: The mean follow-up was 8 months (3-24). Mean wrist range of motion was 33 ° (20-60) of flexion, 48 ° (30-70) of extension and a mean pronation-supination arc of 160 ° (140-180). Mean grip force was 11 kg (5-20). 8 patients had no pain at last follow-up. 3 surgical revisions occurred during the follow-up. A case of early infection (2 weeks) required irrigation and debridement with retention of the implant and antibiotherapy for 3 months. One patient had a distal radioulnar arthritis treated by ulnar distal resection (Darrach procedure). Finally, radiocarpal instability occurred in one patient at 6 weeks postoperatively with anterior radiocarpal dislocation. X-rays at the last follow-up did not reveal any implant or carpal ulnar translation.

Discussion: Distal radius hemi-arthroplasty provided rapid recovery, satisfactory early outcome for pain relief and functional wrist motion in elderly patients with C3 distal radius. Despite a 18% revision rate (n=3), this option seems better than open reduction and internal fixation in independent elderly patients with C3 type fractures. A long-term follow-up and comparative study are needed to confirm our hypothesis.

FM37

Digitalization of the IOM: A comprehensive cadaveric study for obtaining three-dimensional models and morphological properties of the forearm's interosseous membrane *(8225)*

Dr. Fabio Carrillo[1]; Simon Suter[1]; Dr. Fabio A. Casari[1]; PD Dr. Reto Sutter[1]; Prof. Dr. Ladislav Nagy[1]; Prof. Dr. Jess G. Snedeker[2]; Prof. Dr. Philipp Fürnstahl[1]

[1] Universitätsklinik Balgrist; [2] ETH Zürich, Institute for Biomechanics

Introduction: Current preoperative planning of forearm orthopedic surgeries is limited to bone-only procedures. A more comprehensive analysis of forearm pathologies requires clinically reliable models able to consider the soft tissue influence into the motion analysis. However, important properties required for the construction of accurate computer simulations of dynamic forearm models are still missing. In this work, we aim to address this problematic by generating three-dimensional (3D) morphological and tensile properties of the individual ligaments of the forearm's interosseous membrane (IOM) that are currently missing.

Methods: A novel combination of micro- and standard-CT acquisitions was performed on 5 fresh-frozen cadaver forearms for generation of 3D models of radius, ulna and individual ligaments of the IOM: distal oblique bundle (DOB), distal accessory band (AB), central band (CB) and dorsal oblique accessory cord (DOAC). Afterwards, novel 3D methods were developed to measure ligament attachments, width, fibre direction, thickness and cross-sectional area (CSA), which were validated against common ex-vivo measurements. Finally, we investigated the elastic modulus (EM), ultimate force (UF) and stiffness (ST) of each IOM ligament.

Results: 3D models of radius, ulna and corresponding IOM ligaments of the 5 forearms were successfully generated and are available for public download. Obtained average thickness from the 3D methods was (in mm): CB 3.5 (SD 1.5), AB 3.1 (SD 1.7) and DOAC 4.7 (SD 1.6), with an average difference to the ex-vivo measurements of 0.1, 0.3 and 0.8 mm respectively. In terms of the tensile properties, the CB was capable of withstanding a higher load with average UF of 187.9 N, EM of 8.2 MPa and ST of 43.5 N/mm, 63% higher than that of the DOB (UF: 69.4 N, EM: 10.3 MPa, ST: 23.6 N/mm), 46% higher than the AB (UF: 101.8 N, EM: 20.2 MPa, ST: 42.1 N/mm) and 5% higher than the DOAC (UF: 178.5 N, EM: 56.6 MPa, ST: 77.2 N/mm). Our results are consistent with previous findings, where the CB and the DOAC represent the IOM ligaments with the highest stiffness, possibly providing most of the stability during pro-supination motion.

Conclusion: The present study is the first one to publicly provide 3D models of the ulna, radius and IOM ligaments, based on cadaveric data. We have successfully generated 3D morphological data of the IOM ligaments that were hitherto missing and provided the basis for future development of dynamic forearm models.

FM38

Mid-term clinical and radiographic results of 3D planned and navigated intra-articular corrective osteotomies of the distal radius *(8335)*

Dr. Sarvpreet Singh; Dr. Lukas Jud; Prof. Dr. Andreas Schweizer; Prof. Dr. Nagy Ladislav; Prof. Dr. Philipp Fürnstahl; Dr. Simoner Roner

Purpose: Investigation of clinical and radiological mid-term results of corrective osteotomies of the distal radius for malunited intra-articular distal radius fractures with 3-dimensional planning and navigation by the use patient-specific instruments.

Background: Malunion of intra-articular distal radius fractures are correlated with development of osteoarthritis of the radiocarpal joint. An intra-articular corrective osteotomy is an established surgical treatment option to restore joint congruency. However, an intra-articular corrective osteotomy is a complex surgical task. Therefore 3-dimensional planning and navigation are proven to be helpful in such cases. So far, solely small case series are reported, investigating the results of intra-articular corrective osteotomies by this promising method and mid-term results are lacking in the current literature.

Methods: All patients that underwent intra-articular corrective osteotomies of the distal radius due to a malunion by the use of 3-dimensional planning and navigation by patient-specific instruments from October 2008 to January 2015 in our clinic were included. Pre- and postoperative clinical scores were collected and osteoarthritis grading was performed using conventional radiographs. Additionally, evaluation of the articular step-off in pre- and postoperative CT was performed.

Results: In total, 15 patients could be included with a mean follow-up of 6 years (4.1 - 10.4 years). Preoperative osteoarthritis grading showed to be in average 0.4 (0-1 degree) and postoperative 0.9 (0-2 degree). At the follow-up, in 13 cases (87%) the severity of the osteoarthritis did not change or increased less than 1 degree. In two cases a progression of osteoarthritis equal or more than 1 degree was observed. Compared to preoperatively, the patients demonstrated a mean improvement of the grip strength of +14.9 kg (+/- 13.0). Regarding the average of the subjective scores, a PRWE score of 11.0 (+/- 12.5), DASH score of 9.5 (+/- 10.4) and mean residual pain of 0.6 (+/- 1.4) on the VAS scale was reported at the follow-up.

Conclusion: Mid-term results of corrective osteotomies for intra-articular malunions of the distal radius by the use of 3-dimensional planning navigation with patient-specific instruments showed excellent subjective scores and no or minimal progression of the osteoarthritis degree.

FM39

3D planning and navigation by patient-specific instruments in distal radius fractures – A prospective pilot study *(8336)*

Dr. Simon Roner[1]; Fabio Casari; Andreas Schweizer; Ladislav Nagy; Prof. Dr. Philipp Fürnstahl

[1] Universitätsklinik Balgrist

Introduction: 3D planning and surgical navigation by patient-specific instruments have become the state-of-the-art regarding the accuracy in elective forearm surgery. By accelerating the production process, the intervention can now be carried out within 2-3 days. Therefore, its advantages could be used in the treatment of distal radius fractures and thus improve the current treatment gold standard. In the present prospective pilot study, we want to investigate the accuracy and the clinical outcome in 3D planned and navigated osteosynthesis of intra-articular distal radius fractures.

Methods: Six patients with newly diagnosed fractures of the distal radius were included. The CT data of the fracture was segmented to 3D bone models and then reduced anatomically with specific planning software. Subsequently, the osteosynthesis plate was selected according to the fracture pattern and the morphology of the distal radius. Depending on the approach, some of the fragments were accessible for the application of patient-specific instruments derived from the surgical plan. In the remaining fragments, the reduction was performed freehand considering the navigated fragments and verified with an intraoperative X-ray. The navigation accuracy (3D distance and 3D angle) was analyzed by comparing the result with the 3D surgical plan including a subgroup analysis between navigated fragments and freehand reduced fragments. Clinical parameters (ROM, grip strength) and subjective scores (PRWE, DASH) were assessed at the 1 year follow up.

Results: In total, 10 fragments (42%) could be treated by intraoperative surgical navigation and 14 (58%) with freehand reduction of the fragment. In the navigated group, a residual 3D distance of 2.1 mm and a 3D angle of 2.2° was measured compared to 8.6 mm and 12.0° in the freehand group. The mean PRWE-Score of 9.3 (0 – 23.3) and a mean DASH score of 8.4 (0 – 39.8) was measured at the follow-up.

Conclusion: Our prospective pilot study demonstrates the feasibility and a high navigation accuracy (3D distance of 2.1 mm and 3D angle of 2.2°) of 3D planning and intraoperative navigation in the setting of acute fractures. However, not all fragment surfaces (42%) are accessible for the use of patient-specific instruments. We believe, computer-assisted surgical navigation methods without the need for using bone surface will have more potential in the application of fracture osteosynthesis.

FM40

Contemporary possibilities of upper extremity prosthetic fitting - Sports prosthesis or simply sports with prosthesis? *(8439)*

Patrick Meier

Rehaklinik Bellikon

Introduction: Despite the increasing possibilities of surgical treatment and also the reconstruction possibilities for complex injuries, malformations or malignant diseases of the upper extremity, prosthetic fittings are necessary to improve function and also social and professional reintegration. Like medical progress, the possibilities and options in prosthetics have also developed. Above all, prostheses must and can adapt to the increasing demands of young patients in their professional and leisure life as well as to the sporting challenges. What is possible and how can we achieve this?

Material and method: In our clinic, about 50 patients a year are fitted with prostheses for the upper extremities. Of these, 50% are fitted with functional cosmetic prostheses, 10% with mechanical prostheses, 40% with hybrid and myoelectric prostheses, 20% of these with multi-articular hands.

Results: We report on the different needs and the possibilities of prosthetic fitting of the upper extremity with functional myoelectronic prostheses with multi-joint replacement after amputation at lower or upper arm level with different types of control. In addition to a strong commitment to regain a foothold in everyday working life, a considerable number of our customers are reorienting their active leisure activities and sporting opportunities. Golf, mountainbiking, snowboarding and even climbing isn't a dream, it's possible.

Discussion and conclusion: Prosthetic fitting after upper extremity amputations enable an independent life with return to working life, a minimum of social stigmatization and a return to sports additionally. This knowledge may help the orthopedic surgeon in difficult discussions with patients about upper extremity amputations and shows a perspective for all involved.

FM41

Early clinical outcomes of corrective computer-assisted radius osteotomies navigated with patient specific instrumentation in the active patient. – A prospective cohort study. *(8454)*

Dr. Fabio A. Casari; Prof. Dr. Ladislav Nagy; Prof. Dr. Philipp Fürnstahl; Prof. Dr. Andreas Schweizer

Balgrist Universitätsklinik

Introduction: The radius is one of the most commonly fractured bones in the human body. If the facture heals in malposition, patients commonly suffer from persisting pain or reduced range of motion (ROM). Quantification of the deformity in plain imaging is projection dependent with no reliable quantification for rotational components. We treated patients suffering from the described pathology using preoperative 3D analysis, computer-assisted surgical planning and patient specific instrumented corrective procedure. The postoperative outcome was then analyzed for exact quantification of accuracy and improvement of the clinical condition.

Methods: This prospective study included 33 patients with deformity of the radius. Pre- and postoperative PRWE with subscores, ROM, and joint step-off in mm, was recorded. Six groups were defined by osteotomy site, executed intraarticular correction and surgical indication of pain or reduced ROM. Preoperative CT-scans were reconstructed in 3D using segmentation and 3D model generation. All models were imported into our surgery planning software CASPA (Computer-Assisted-Surgery-Planning-Application) and a surgical plan was conceived. For surgical navigation patient specific instruments (PSI) were designed and 3D printed using a selective laser sintering device. The corrective procedures were then performed by two senior hand surgeons, LN, AS. From the postoperative CT-scans 3D models were generated as described. The postoperative radius was then superimposed to the planned surgical outcome model using the CASPA software to determine accuracy.

Results: The mean age of the study population was 41.42 years (SD 15.51), 21 male/ 12 female patients. The mean scores are reported. In 21 patients with pain, PRWE-pain reduced by 45.9%, 35.65 (SD 2.67) to 19.29 (4.34); p=0.004. 6 Patients with reduced wrist flexion/extension increased ROM by 108.5%, 37.5° (SD 13.33°) to 78.18° (SD 16.56°); p=0.003. 6 Patients with reduced pronation/supination increased ROM by 64.9%, 47.5° (SD 7.21°) to 78.33° (2.63°); p=0.005 . 6 distal intraarticular radius corrections reduced step-off (mm) by 51.8%, 1.95 (SD 0.38) to 0.91 (SD 0.15); p=0.017. 9 distal intra- and extraarticular corrections reduced step-off (mm) by 56.5%, 2.00 (SD 0.46) to 0.87 (SD 0.17); p=0.043.

Conclusion: Significant improvement presented in the results confirms that the method of computer assisted radius osteotomies navigated by PSI provides clear clinical benefit to the patient.

FM42-FM55: SPINE

FM42

Unexpected infections in pseudarthrosis after spinal fusions *(8301)*

Dr. Marco Burkhard; Ruben Loretz; Dr. David Bauer; PD Dr. Ilker Uckay; PD Dr. Michael Bet; Prof. Dr. Mazda Farshad

Universitätsklinik Balgrist

Introduction: Unexpected occult infection in revision spine surgery has been reported to occur in 9 to 56%, with pseudarthrosis being a major predictor. However, the rate of occult infection in pseudarthrosis per se has so far not been evaluated. The aim of this study was to find the incidence of unexpected infections in presumed aseptic lumbar pseudarthrosis and its correlation with patient demographics and inflammatory markers.

Methods: We retrospectively reviewed all patients who underwent revision surgery of presumed aseptic (thoraco-)lumbar pseudarthrosis between 2014 and 2019 at a single institution. Patients were included only with full microbiologic workup. Perioperative data and inflammatory markers were compared between patients with and without microbiologically confirmed infectious pseudarthrosis.

Results: In total 152 patients underwent lumbar pseudarthrosis revision surgery, of which 128 (84%, age 65 ± 14 years, 45% female) had full microbiologic samples (≥3 tissue samples) and were included. The samples were positive in 13 patients (10.2%). Cutibacterium acnes was the predominant bacteria (46.2%) followed by Staphylococcus (38.5%). Neither age, gender, ASA-class, CCI, diabetes and smoking status did differ between the groups. The incidence of occult infection did however correlate with BMI (30.9 ± 4.7 (infected) vs 28.2 ± 5.6 (controls), p=0.049). There were no differences in number of prior lumbar surgeries or levels fused. However, patients with fusions involving T12-L1 were more likely to have an occult infection (46% vs 18%, p=0.019). Preoperative laboratory markers did significantly differ, with CRP and rate of elevated CRP (>5.0 mg/l) being significantly higher in patients with occult infection (9.4 ± 8.0 vs 5.7 ± 7.1 mg/l, p=0.031; 66.7% vs 32.3%, p=0.049). There was no significant difference in length of hospitalization (9.4 ± 4.7 vs 7.1 ± 2.6 d), length of surgery (193 ± 71 vs 188 ± 89 min) and blood loss (475 ± 340 vs 354 ± 239 ml) of the patients with occult infections versus the controls, respectively.

Conclusion: In our study, 10.2% of patients with pseudarthrosis after spinal fusion had an unexpected underlying low-grade infection. Higher BMI, fusions including the thoracolumbar junction and higher CRP-levels were associated with presence of occult infections. We herewith emphasize the importance to obtain full microbiologic workups to ultimately rule out an infection in all pseudarthrosis revision surgeries of the spine.

FM43

Biomechanical Performance of Bicortical Versus Pericortical Cortical Bone Trajectory (CBT) Pedicle Screws *(8320)*

Dr. José Spirig[1]; Elin Winkler[1]; Frédéric Cornaz[1]; Marie-Rosa Fasser[2]; PD Dr. Michael Betz[1]; Prof. Jess Snedeker[2]; Jonas Widmer[2]; Prof. Dr. Mazda Farshad[1]

[1] Balgrist Universitätsklinik; [2] Universitätsklinik Balgrist / Institute for Biomechanics, ETH Zurich

Introduction: The cortical bone trajectory (CBT) is an alternative to the traditional pedicle screw trajectory in posterior spine instrumentation, enhancing screw contact with cortical bone and therefore increasing fixation strength. Additional to the trajectory, insertion depth (pericortical vs bicortical placement) could be a relevant factor for the fixation strength. However, the potential biomechanical benefit of bicortical placement of CBT pedicle screws is unknown. We aimed to quantify the fixation strength of pericortical versus bicortical cortical bone trajectory (CBT) pedicle screws in a randomized cadaveric study.

Methods: Pedicle screws were either placed peri- or bicortical with a CBT in 20 lumbar vertebrae from four human spine cadavers by using patient specific templates. Instrumented specimens underwent screw toggle testing (1.800.000 cycles, 10 Hz) under physiological loading conditions, including shear and tension loads as well as bending moments. Translational and angular displacement of the screws were quantified and compared between the two techniques.

Results: Even if bicortical screws tend to have a greater resistance against cyclic loading and an increased stability in angular direction, these values were not significantly different when compared to pericortical screws.

Conclusion: Although bicortical screws tend to have a greater fixation strength than pericortical CBT screws, these values were not significant. Therefore, screws with a CBT should not be aimed to be placed bicortically, as no relevant biomechanical advantage is gained while the potential risk for complications to anterior structures to the spine is increased.

FM44

Global balance of the spine, an independent contributor to physical function, and falls in older adults: the SAFE cohort study *(8370)*

Melany Hars[1]; Dr Antonio Faundez[2]; Dr Jacques Fechtenbaum[3]; Dr Karine Briot[3]; Dr Christian Roux[3]; François Herrmann[1]; Prof. Dr Serge Ferrari[1]; PD Dr Stéphane Genevay[1]; PD Dr Sana Boudabbous[1]; Prof. Dr Andrea Trombetti[1]

[1] Hôpitaux universitaires de Genève (HUG); [2] Hôpital La Tour, Hôpitaux Universitaires de Genève; [3] Hôpital Cochin Paris

Introduction: Falls are common among older adults and remain the leading cause of fractures. They may result from several intrinsic and extrinsic risk factors. Among them, the role of the global balance of the spine has never been fully established. We conducted a preliminary cross-sectional analysis to determine the association between global balance of the spine, physical function and falls in community-dwelling older adults.

Methods: The SAFE study is an ongoing prospective, longitudinal cohort study conducted in Geneva (Switzerland) among community-dwelling adults aged ≥65 years without history of instrumented spinal surgery. All subjects underwent a comprehensive assessment battery including: full skeleton 2D/3D radiographs in the standing position by EOS® low-dose biplane X-ray imaging system, DXA imaging, clinical examination, fall history in the past 12 months, and physical function tests. Spino-pelvic parameters collected included, among others, the spino-sacral angle (SSA) and the C7-central sacral line (C7-CSL) distance for sagittal and coronal balance, respectively.

Results: In this preliminary analysis, 50 subjects (mean age, 74 years; 76% female) were included. Among them, 18 (36%) reported one or more falls in the past 12 months, 19 (38%) reported a history of low-trauma fracture, 15 (30%) were osteoporotic, while 12 (24%) had a Short Physical Performance Battery (SPPB) score ≤9. Global sagittal balance was independently associated with physical performances after controlling for potential confounders (adjusted regression coefficient for SPPB score and SSA= 0.09, 95% CI [0.03, 0.16]; p=0.007), as well as some sagittal pelvic and lumbar curve measures. After controlling for age, sex, comorbidities, vertebral fractures and SPPB score, increased C7-CSL distance was independently associated with increased fall risk (OR=2.28, 95% CI [1.06, 4.92]; AUC=0.79, 95% CI [0.65, 0.92]).

Conclusion: The findings of this study suggest that global balance of the spine is an independent contributor to physical impairments and falls in older adults. Further analysis from this longitudinal cohort study will reveal the role of compensating mechanisms in the sagittal plane, and should help to clarify whether global balance of the spine relates to incident falls and fractures in older adults.

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FM45

Sarcopenia according to EWGSOP2 is associated with global sagittal imbalance of the spine in older adults: the SAFE cohort study *(8375)*

Melany Hars[1]; Dr Antonio Faundez[2]; Dr Jacques Fechtenbaum[3]; Dr Karine Briot[3]; Dr Christian Roux[3]; François Herrmann[1]; Prof. Dr Serge Ferrari[1]; PD Dr Stéphane Genevay[1]; PD Dr Sana Boudabbous[1]; Prof. Dr Andrea Trombetti[1]

[1] Hôpitaux universitaires de Genève (HUG); [2] Hôpital La Tour, Hôpitaux Universitaires de Genève; [3] Hôpital Cochin Paris

Introduction: Aging is typically associated with degenerative processes affecting all structures of the spine, leading to the risk to develop a sagittal imbalance. Whether the loss of skeletal muscle mass and function that accompanies ageing, or sarcopenia, contributes to global sagittal imbalance has never been fully established. In this study, we aimed to investigate the association between sarcopenia, as defined based on the recent EWGSOP2 definition, and global sagittal balance of the spine in community-dwelling older adults.

Methods: A preliminary cross-sectional analysis was conducted on the first 50 subjects enrolled in the SAFE study, an ongoing prospective, longitudinal cohort study recruiting community-dwelling adults aged ≥65 years without history of instrumented spinal surgery. Global sagittal balance of the spine was assessed by full skeleton 2D/3D radiographs in the standing position by EOS®, a low-dose biplane X-ray imaging system. Muscle mass was assessed by dual-energy X-ray absorptiometry, and muscle strength using handgrip strength and five-times chair stand tests. Sarcopenia was defined according to EWGSOP2 criteria. Global sagittal balance was measured through the newly described OD-HA (odontoid-hip axis) angle [1]. Univariate and multivariate regression models, and the area under receiver operating characteristic curves (AUCs) were computed.

Results: Subjects had a mean age of 74.3±6.1 years and 76% were female. Prevalence of EWGSOP2-defined low muscle mass was 48%, low muscle strength was 20% and sarcopenia was 12%. Sarcopenic subjects were more likely to present global sagittal imbalance (83% vs 24%; p=0.004). In multivariate regression analysis controlling for age, sex, comorbidities and vertebral fractures, sarcopenia was independently associated with global sagittal imbalance (p=0.011). The adjusted AUC was 0.82, 95% CI [0.67, 0.96].

Conclusion: These results suggest that sarcopenia, as defined based on EWGSOP2 definition, is associated with global sagittal imbalance of the spine in older adults. Longitudinal analysis will be required to elucidate the temporality and causality of this association.

Reference

[1] Le Huec JC, et al. Sagittal balance of the spine. Eur Spine J. 2019;28(9).

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FM46

Cell-matrix adhesion of bone marrow stromal cells in Modic type 1 changes is increased and relates to increased expression of integrin β1 *(8394)*

Irina Heggli[1]; Susanne Epprecht[1]; Tamara Mengis[1]; PD Dr. Astrid Juengel[1]; PD Dr. Michael Betz[2]; Dr. José Spirig[2]; Dr. Florian Wanivenhaus[2]; PD Dr. Florian Brunner[3]; Prof. Dr. Mazda Farshad[2]; Prof. Dr. Oliver Distler[1]; Dr. Stefan Dudli[1]

[1] Center of Experimental Rheumatology, University of Zurich; [2] Department of Orthopeadic Surgery, Balgrist University Hospital; [3] Department of Rheumatology, Balgrist University Hospital

Introduction: Modic type 1 changes (MC1) are vertebral bone marrow lesions associated with non-specific low back pain (LBP). The pathophysiology of MC1 includes inflammation, fibrosis, and high bone turnover. Bone marrow (BM) stromal cells (BMSCs) are key regulators of these processes. The aim of the study was to identify dysregulated biological processes in MC1 BMSCs contributing to the pathobiology of MC1.

Methods: BM aspirates were obtained from LBP patients with MC1 undergoing lumbar spinal fusion. Aspirates were taken prior to screw insertion. From each patient, a MC1 and a healthy control (HC) aspirate from the adjacent vertebral body was collected. BMSCs were isolated by plastic adherence. RNA from BMSCs was sequenced (n=3+3) and gene ontology of significantly dysregulated genes (p-value <0.05) was analyzed. BMSC adhesion to non-coated-, collagen I-coated-, and fibronectin-coated surface of MC1 and HC (n=8+8) was measured and compared with paired t-test. Gene expression of 15 relevant integrins was measured by quantitative real-time PCR (qPCR). Normalized expressions were compared between MC1 and HC BMSC with paired t-test. Integrin β1 protein level was semi quantitatively analyzed by Western Blot (n=5+5) and normalized to β-Actin expression.

Results: By RNA sequencing, 154 genes were differentially expressed between MC1 and HC BMSCs (p-value ≤ 0.01; log2-ratio ≥ 0.5). Gene ontology enrichment analysis revealed an overrepresentation of the biological process "cell-matrix adhesion" among all significantly regulated genes (p-value <9.3e-13). A change in cell adhesion was corroborated with adhesion assay. Binding (Δ 30min - 15min) to collagen I (MC1 +16%, HC +10%, p-value = 0.10), fibronectin (MC1 +17%, HC +6%, p-value = 0.03), and non-coated surface (MC1 +46%, HC +35%, p-value = 0.05) was increased in MC1. Integrin gene expression analysis revealed significant upregulation of integrin beta-1 gene (ITGB1) in MC1 vs. HC (fold change = 1.24, p-value = 0.047), whereas there was no significant difference between the other integrins tested. On protein level, integrin β1 was upregulated in MC1 in four out of five patients.

Conclusion: Adhesion of BMSCs to matrix and integrin β1 expression are increased in MC1. Integrin β1 is essential for cell-matrix adhesion and an important contributor to the initiation and progression of tissue fibrosis, a hallmark of MC1. Therefore, BMSCs and integrin β1 might be relevant novel targets for the treatment of MC1

FM47

A disappointing level of interobserver agreement for the classification of fragility fracture of the pelvis – is a clinical use justified? *(8466)*

Dr. Michaela Ramser[1]; Nathalie Strub; Prof. Werner Vach[1]; PD Dr. Henrik Eckardt[1]; PD Dr. Franziska Saxer[2]

[1] Universitätsspital Basel; [2] Crossklinik

Introduction: Pelvic fractures in elderly osteoporotic patients are typically associated with a low-energy trauma like a fall from standing or sitting position. These fractures are relatively stable, allowing conservative treatment with protected or full weightbearing. To underline the clinically relevant difference of these fracture pattern compared to pelvic fractures after high-energy trauma, a separate classification for the fragility fractures of the pelvis (FFP) has been introduced by Rommens/Hofmann. Previously, three small studies have shown "fair" to "modest" levels of interobserver agreement. The aim of our project was to analyse the applicability and reliability of the classification in daily routine in a large population of patients with an FFP.

Methods: The CT pelvic scans of patients presenting at our emergency department after a low energy fall, that resulted in an FFP were analysed. The study was approved by the EKNZ (2017-01859). Fracture classification was performed in two different rounds (approximately one year apart) independently by a junior (JS) and senior surgeon (SS). For both rounds, inter- and intraobserver agreement were assessed.

Results: A total of 384 patients were analysed. The interobserver agreement from the first and second classification round were 0.45 (Cohens kappa 0.33) and 0.57 (Cohens kappa 0.47), respectively. The change rate from the first to the second round was 13% for the SS and 42% for the JS. The largest disagreement was observed between the main categories II and III (non-dislocated vs dislocated dorsal fractures).

Conclusion: In this large population suffering an FFP, classification of the fractures using the Rommens classification resulted in an only "modest" level of interobserver agreement. This is of concern since it is assumed that the instability increases with each category. A modest interobserver reliability could therefore have a negative impact on clinical decision making. For unstable fractures, Rommens and several others recommended surgical stabilisation of the sacrum. Particularly the fact that only dorsal dislocation is mirrored in the FFP classification and indirect signs of instability such as the number and location of fracture lines are ignored is in our view problematic. We are currently validating a modified classification with a different focus. This could potentially improve its interobserver reliability and therefore its clinical relevance.

FM48

Histopathology of Modic Changes *(8472)*

Dr. Stefan Dudli[1]; Dr. Dominik Hänni; Irina Heggli; PD Dr. Astrid Juengel; Urs Ziegler; Michael Betz; José Spirig; Florian Wanivenhaus; Florian Brunner; Prof. Dr. Mazda Farshad; Oliver Distler

[1] Center of Experimental Rheumatology, University of Zurich

Introduction: Modic changes (MC) are specific for chronic low back pain. Despite the high prevalence of MC, the histopathology of MC remains poorly understood. The only published histological data from clinical MC biopsies are from Michael Modic's original paper. Based on three biopsies, he described Modic type 1 changes (MC1) as vascularized fibrous tissue and Modic type 2 changes (MC2) as yellow marrow replacement. No histomorphometric data is available that would help to understand the pathophysiology of MC. The aim of this study was to characterize MC histomorphometry with multiphoton excitation microscopy (MPE), histology, and immunohistochemistry (IHC) in order to better understand MC pathophysiology.

Methods: From patients undergoing lumbar spondylodesis, bone marrow biopsies (n=3 MC1, n=5 MC2, n=6 control; based on T1- and T2-weighted MRI) were taken through pedicle screw trajectory before screw insertion. Fixed biopsies were analyzed en-bloc with MPE and as paraffin sections with histology and IHC. MPE: second-harmonics-generation (SHG) of collagen and tissue autofluorescence were recorded of large volumes. Sections were stained histologically (eosin/hematoxylin, masson trichrome) and analyzed with IHC for alpha smooth muscle actin (aSMA), collagen-1, collagen-3, cellular fibronectin, and CD68 (macrophages).

Results: In MC1, hematopoietic marrow was replaced with increased number of adipocytes. Fibrotic marrow changes were found in 2 of 3 MC1 biopsies and were accompanied by increased vascularization. No myofibroblasts positive for α-smooth muscle actin were found in fibrotic areas. Collagen-1 was exclusively found in fibrotic marrow. Collagen-3 and fibronectin fibers were present in fibrotic areas but were also found in control marrow. In MC2, hematopoietic marrow was replaced by adipocytes with little marrow fibrosis. Macrophages were not increased in MC1 and MC2. Fibrotic marrow was best identified and visualized with MPE using SHG.

Conclusion: The historical MC1 histopatology paradigm "fibrovascular granulation tissue" needs to be re-evaluated. First, because fibrosis was not a consistent characterization of MC1, and second, because increased number of adipocytes has been associated until now with MC2. Adipocyte abundance in MC1 along with spatial tissue heterogeneity suggest phases of MC1 flare-ups and MC2 remissions. Therefore, subphenotypes of MC1 exist and question the T1- and T2-weighted MRI-based MC classification.

FM49

A prospective, controlled, multicentre study to evaluate the association between "appropriate use of surgery" and outcome in degenerative spondylolisthesis *(8516)*

PD Dr. Anne F. Mannion[1]; Francine Mariaux; Dr. Tamas F Fekete; Dr. Frank Kleinstück; PD Dr. Dezsö Jeszenszky; Dr. Markus Köhler; PD Dr. Daniel Haschtmann; Dr. Jon Lurie; Dr. Adam Pearson; Dr. Philippe Otten; Dr. Michael Norberg; PD Dr. Markus Loibl; Dr. V

[1] Schulthess Klinik

Introduction. Identification of appropriate candidates for spine surgery is important to optimise outcomes and prevent unnecessary risks and expenses. Appropriate Use Criteria (AUC) serve to help clarify the indications for a procedure. We evaluated the short-term outcomes of patients with lumbar degenerative spondylolisthesis (LDS) classified as appropriate or otherwise for surgery using a recently developed appropriateness algorithm(1).

Methods. This was a prospective, controlled, multicentre (5 in Switzerland; 1 in USA) study of 736 patients (493 surgical and 244 nonsurgical controls; 70±10y; 67% female) with a first follow-up (FU) after treatment. The AUC were used to judge the appropriateness of surgery for each patient, based on the presenting symptoms and a constellation of variables documented at baseline. Patients completed the Core Outcome Measures Index (COMI) at baseline and 3 months' FU. The care plan (surgery or nonsurgical care) was decided at the discretion of the treating physician, as per their normal practice and irrespective of the criteria. The data were analysed using repeated measures ANCOVA.

Results. According to the AUC, surgery of some type was considered appropriate (A) in 143/493 (29%), uncertain (U) in 230/493 (47%) and inappropriate (I) in 120/493 (24%) of the surgical patients; it would have been A in 43/244 (18%), U in 94/244 (38%) and I in 107/244 (44%) of the nonsurgical patients. As per convention, A and U groups were combined, to compare with I. There was a significant interaction (p=0.02) between the change in COMI score from baseline to 3mo FU in relation to treatment group and appropriateness for surgery: the benefit of surgery over nonsurgical care was greater in patients for whom surgery was considered A/U (2.9-point greater reduction in COMI) than in those for whom it was I (1.8-point greater reduction). In patients A/U for surgery, the COMI minimal clinically important change (MCIC) score was reached by 76% who got surgery and 27% who got non-surgical care; in those who were I for surgery, it was reached by 61% patients who got surgery and 26% who got non-surgical care.

Conclusion. The AUC were able to successfully identify patients who derived greater benefit from surgery. Though 3-mo results typically predict 12-mo results, the findings should nonetheless be confirmed by analyses of the 12 mo-FU data. Validation of the AUC for surgery for LDS should support their widespread adoption for quality improvement.

FM50

Non-medical determinants of length of hospital stay for surgery for degenerative spine disorders. *(8519)*

Domenique Mai; Dr. Christian Brand; PD Dr. Daniel Haschtmann; Dr. Tatiana Pirvu; Dr. Tamas F Fekete; PD Dr. Anne F. Mannion[1]

[1] Schulthess Klinik

Introduction. Unnecessarily long hospital stays are costly and inefficient. Studies have shown that the length of hospital stay (LOS) for spine surgical procedures is influenced by various disease-related or medical factors but few have examined the role of sociodemographic/socioeconomic (SDE) factors.

Methods. This was a retrospective analysis of data from 10,770 patients (5,056 men, 5,714 women; 62±15y) with degenerative spinal disorders, collected prospectively in an in-house database within the framework of EUROSPINE's Spine Tango Registry. Surgeons completed the Tango surgery form (clinical history, demographics, surgical measures, complications), and patients, a baseline Core Outcome Measures Index. Stepwise linear regression analyses examined SDE predictors of LOS, controlling for potential medical/biological factors.

Results. The mean LOS was 7.9 ± 5.2 days. The final model accounted for 42% of variance in LOS, with SDE variables explaining 13% variance and medical/surgical predictors, 29%. In the final model, the SDE factors age and being female were significant independent predictors of LOS, whereas others were either non-significant (insurance status, being of Swiss nationality, being a smoker) or reached only borderline significance (p<0.1) (BMI). Controlling for all other SDE and medical/surgical confounders, being female was associated with 1.11-day longer LOS (95%CI,0.96-1.27;p <0.0001).

Conclusions. Patients of advanced age and female gender are at increased risk of longer hospital stay after surgery for degenerative spinal disorders. Further studies should seek to understand the reasoning behind the gender disparity, in order to minimize potentially unnecessary costs of prolonged LOS. Targeted pre-operative discharge planning may improve the utilisation of hospital resources.

FM51

Full-Body Digital X-Ray (LODOX-Statscan) has a Poor Diagnostic Accuracy in Detecting Spine Injuries in Polytraumatized Patients *(8541)*

Sonja Häckel[1]; Elena Hofmann[2]; Jasmin Basedow[3]; Sebastian Bigdon[1]; Helen Anwander[1]; Christoph Albers[1]; Robert Dunn[4]; Sithombo Maqungo[4]; Marius J. B. Keel[5]; Aristomenis Exadaktylos[1]; Sven Hoppe[1]

[1] Inselspital Bern; [2] Universitätsklinikum Bonn; [3] Sonnenhof - Bern; [4] University of Cape Town; [5] Trauma Zentrum Hirslanden

Introduction: Spinal fractures are present in 16-31% of polytraumatized patients. Rapid identification of spinal injuries that require immobilization

or operative treatment to prevent subacute neurological complications is essential. The Lodox-Statscan (LS) has evolved into a promising time-saving diagnostic tool. A full-body AP-Lodox X-ray with minimal radiation dose is completed within 13 seconds. The objective of this study was to analyze the diagnostic accuracy of AP-LS to detect spinal fractures in polytraumatized patients.

Methods: We retrospectively analyzed CT scans and AP-Lodox X-rays of 320 polytraumatized patients (ISS >16) at our Level 1 trauma center. Three independent observers (radiology and orthopedic attending, and an orthopedic resident) diagnosed the AP-LS X-rays. The sensitivity and specificity of fracture diagnosis using LS compared to the gold-standard CT were calculated by crosstabulation. The ROC (receiver operating characteristic)-curve was analyzed to determine the area under the curve for diagnostic accuracy. Interrater reliability between the three observers was calculated using Fleiss' Kappa.

Results: 64% of patients showed a spinal injury on CT. The main injury sites were the thoracic (n=97) and the lumbar spine (n=94). LS had a low sensitivity of 9% (range 0-24%), and high specificity of 99% (range 98-100%) independent of the fracture localization. The Interrater reliability was poor for cervical fractures (kappa <0.00) and fair for thoracic fractures (kappa 0.215). 14% of thoracic and 12% of lumbar fractures were identified, whereas 10% of sacropelvic fractures were correctly diagnosed. Only 1% of cervical fractures were correctly diagnosed. C type fractures were identified in 27%, whereas B- and A-type fractures were identified in 6% respectively 9%.

Conclusion: The detection of thoracic, lumbar, and sacropelvic fractures on AP-LS was more successful than the detection of cervical fractures. The diagnostic accuracy was best for C-type injuries. This study demonstrated that in a setting challenged with high patient numbers and limited CT availability, the Lodox scan facilitated a low cost and fast bedside screening of the critically ill trauma patient. Hence, a CT scan remains the imaging technique of the first choice in the case of a suspected spinal injury.

FM52

Development of a model to predict the likelihood of incurring a complication in patients undergoing surgery for degenerative disorders of the lumbar spine *(8543)*

Pascal Zehnder[1]; PD Dr. Ulrike Held[2]; Dr. Andrea Luca[3]; Dr. Everard Munting[4]; Dr. Tim Pigott[5]; Dr. Tamas Fekete[6]; Prof. Dr. Oliver Distler[7]; PD Dr. Daniel Haschtmann[6]; Dr. Raluca Reitmeir[6]; PD Dr. Markus Loibl[6]; PD Dr. Anne Mannion[6]

[1] Universität Zürich, Medizinische Fakultät; [2] Institut für Epidemiologie, Biostatistik und Prävention, Universität Zürich / Schweiz; [3] IRCCS Istituto Ortopedico Galeazzi; [4] Clinique Saint-Pierre; [5] The Walton Centre NHS Foundation Trust; [6] Schulthess Klinik, Zürich

Introduction: Previous studies have identified several factors influencing the likelihood of incurring a complication during spine surgery for degenerative disorders of the lumbar spine. These include previous spine surgery, age, comorbidity, complexity of the surgery, BMI, smoking, and others. The aim of this study was to identify predictors from a large international spine registry data base and to develop a multivariable model to predict the probability for complications perioperatively.

Methods: The data were extracted from EUROSPINE's International Spine Tango Registry. Medical history and surgical details had been documented using the Tango surgery form, as had surgical and general medical complications arising between admission and discharge. Separate prediction models were built for surgical and general complications. Predictors were age, gender, previous spine surgeries at the same level, additional pathologies, BMI, smoking status, morbidity and Mirza-score. For model development, all predictors were evaluated simultaneously in a multiple logistic regression approach. A complete-case approach was taken. The discriminative ability was addressed as area under the receiver operating characteristic curve (AUC), and 95% confidence interval.

Results: Data were available for 68'111 patients operated between Jan. 2012 and Dec. 2017. 43'461 were patients with degenerative lumbar disorders, aged 18 to 95 years, and 23'873 of them were available for complete case analysis. A general medical complication was reported in 766/23'873 (3.2%) patients, most commonly postoperative kidney/urinary problems (202; 0.8%) and a surgical complication in 2559/23'873 (10.7%), most commonly dural tear (1653; 6.9%). The most important predictor for surgical complication was previous surgery at the same level (odds ratio (OR) 1.96; 95% CI 1.76 – 2.18, p-value < 0.001). For general complications it was the ASA-Score (ASA-2 OR 1.59; 95% CI 1.21 – 2.14; p-value = 0.001, ASA-3 OR 3.09; 95% CI 2.27 – 4.25; p-value < 0.001, ASA-3 OR 5.80; 95% CI 3.03 – 10.59; p-value < 0.001). The AUC for the model was 0.74 (95% CI: 0.72-0.75) for general complications and 0.63 (95% CI: 0.62-0.64) for surgical complications.

Conclusion: In general, complications were relatively rare. Surgical complications could be predicted with less discriminative ability than general complications. We found that reoperations at the same level were a predominant predictive factor for surgical complications.

FM53

Mesenchymal stem cell secretome as a potential cell free therapy for early intervertebral disc degeneration *(8551)*

Sebastian Wangler[1]; Amir Kamali[2]; Christina Wapp[2]; Dr. Marianna Peroglio[2]; Dr. Lisbet Haglund[3]; Prof. Dr. Lorin M. Benneker[1]; PD Dr. Sibylle Grad[2]; Dr. Mauro Alini[2]

[1] Department of Orthopaedic Surgery, Inselspital, University of Bern, Switzerland; [2] AO Research Institute Davos, Switzerland; [3] Department of Surgery, Division of Orthopaedics, Faculty of Medicine, McGill University, Canada

Introduction: Injection of mesenchymal stem cells (MSCs) into intervertebral discs (IVDs) has been investigated as potential treatment strategy for discogenic low back pain. Recent data indicates that the therapeutic effect of MSCs primarily depends on their trophic activity. MSC secretome has therefore significant therapeutic potential, though its composition needs to be characterized for clinical translation. This work aimed to analyze and compare the secretome of MSCs stimulated with conditioned medium from healthy, traumatic and degenerative IVD tissues.

Methods: Degenerative and traumatic human IVD tissue was obtained with written consent from patients undergoing spine surgery. Healthy IVDs were harvested from organ donors after donor and familial consent. IVD tissues were incubated in culture medium for 48 h to generate IVD conditioned medium (CM). Human MSCs (n=12 donors) were isolated from bone marrow aspirates obtained with written consent from patients undergoing spine surgery. Then, MSCs were plated and stimulated with IVD conditioned medium (n=4 for each degenerative, traumatic and healthy IVD group) for 24 h. Conditioned medium was replaced by fresh culture medium in order to collect the MSC secretome during the following 24 h. MSCs stimulated with 10 ng/mL IL-1β served as proinflammatory control (PC), and MSCs incubated with culture medium as basal control (BC). IVD conditioned media and MSC secretome were analyzed by LC-MS/MS proteomics profiling.

Results: Secretome of MSCs stimulated with traumatic and degenerative CM revealed a strong overlap of secreted proteins whereas exposure to IL-1β and healthy CM resulted in a unique protein profile. Following stimulation by healthy, traumatic and degenerative CM, GSEA revealed enriched GO terms for anabolic/catabolic processes including extracellular matrix organization and aminoglycan metabolic process (p/FDR <0.01). After IL-1β stimulation (PC), GO terms related to immune modulatory and inflammation processes were enriched.

Conclusion: Secretome of MSCs stimulated with healthy, degenerative or traumatic IVD conditioned medium was rich in anabolic, catabolic and anti-catabolic molecules, suggesting extracellular matrix remodeling activity. This data indicates that MSCs respond with the release of a defined secretome, depending on the surrounding environment. Further studies will assess the regenerative potential of the identified trophic factors as a novel, cell free treatment strategy.

FM54

Homing of Mesenchymal Stem Cells Enhances Tie2+ Progenitor Cells and Induces a Proliferative Response in Intervertebral Disc Organ Culture *(8556)*

Sebastian Wangler[1]; Dr. Marianna Peroglio[2]; Dr. Ursula Menzel[2]; Prof. Dr. Lorin M. Benneker[1]; Prof. Dr. Daisuke Sakai[3]; Dr. Mauro Alini[2]; PD Dr. Sibylle Grad[2]

[1] Department of Orthopaedic Surgery, Inselspital, University of Bern, Switzerland; [2] AO Research Institute Davos, Switzerland; [3] Tokai University School of Medicine, Japan

Introduction: Homing of human mesenchymal stem cells (MSCs) has been described as potential alternative to MSC injection, aiming to enhance the regenerative capacity of intervertebral discs (IVDs). IVD cells expressing Tie2 (Angiopoietin-1 receptor) represent a progenitor cell population which decreases with aging and degree of IVD degeneration. This results in a potential loss of the IVD's regenerative capacity. The aims of this study were to assess whether MSC homing into an IVD

1. enhances the Tie2 positive progenitor cell population

2. affects the IVD cell survival

3. induces a proliferative response in the IVD.

A bovine whole organ culture model and human IVD tissues from three patient groups (healthy, trauma, degenerative) were used.

Methods: Human MSCs (n=9 donors) isolated from bone marrow aspirates obtained with written consent from patients undergoing spine surgery were labeled with fluorescent dye (PKH26+PKH67).

Bovine: IVDs were isolated from bovine tails (n=27, 6-10 months) and cultured under free swelling conditions. MSCs (1x106) were placed on the endplates of bovine IVDs. Untreated IVDs from same tail were used as controls.

Human: Traumatic and degenerative human IVD tissue was obtained with written consent from patients undergoing spine surgery. Healthy IVDs were harvested from organ donors after donor and familial consent. IVD tissue (n=9) was separated in two equal portions and placed in a 15ml tube respectively. MSCs (1x105) were seeded onto one tissue portion. The other portion was used as untreated control.

After 5 days of co-culture and MSC migration, human and bovine IVD cells were isolated by tissue digestion. Percentages of Tie2 positive, dead (DAPI positive) and proliferative (Ki-67 positive) IVD cells were evaluated by flow cytometry.

Results: MSC homing significantly:

1. increased the proportion of Tie2 positive progenitor IVD cells in bovine IVDs (2.4±1.3-fold; p=0.04) and 7/10 human IVDs

2. decreased the fraction of dead IVD cells in bovine IVDs (0.8±0.4-fold; p=0.02) and 7/10 human IVDs

3. induced a proliferative response in bovine IVDs (2.5±1.9-fold; p=0.013) and 5/6 human IVDs.

Conclusion: Stimulation of bovine and human IVD cells by homed MSCs resulted in an enhanced population of Tie2 positive IVD progenitor cells, induced a proliferative response and reduced IVD cell death. Our findings suggest a prominent role for potentially regenerative, paracrine stimulation following MSC migration into IVD tissue.

FM55

MRI Appearance of the Psoas muscle after XLIF procedure – a follow up study with independent radiological control *(8618)*

Dr. Ferdinand Krappel[1]; Dr. Michael Frey; Dr. Wolfgang Perrig[2]; Dr. Samuel Schmid[1]

[1] Spitalzentrum Oberwallis; [2] Spital Brig

Introduction: Psoas muscle damage and atrophy is seen as a key disadvantage of the extreme lateral interbody fusion procedure (XLIF). We therefore had an MRI performed and the axial cuts assessed by a radiologist independent between 6 and 12 months post operatively

Material and methods: In all, 20 Patients were available for a follow up MRI, the Question for the radiologist was whether there is a difference between the left and right psoas muscle in comparison to the pre- operative MRI using the semi quantitative method of Goutallier

Results: There was only a slight and insignificant difference of posas size, mass and structure using the beween left and right as well as pre- to post op.

Discussion: We therefore conclude that with careful dissection technique, structural damage to the psoas muscle as assessed via post op MRI is not an significant factor. In most cases with a post operative diminution of psoas function patients can be reassured that this will only be temporarily.

FM56-FM74: HIP

FM56

Intraarticular Damage in Patients Undergoing Surgical Hip Dislocation: Beyond Peripheral Labral and Chondral Lesions *(8160)*

Vera Stetzelberger[1]; PD Dr. Simon Damian Steppacher[2]; Prof. Dr. Klaus Arno Siebenrock[2]; Prof. Dr. Moritz Tannast[1]

[1] Cantonal hospital Fribourg, University of Fribourg; [2] Inselspital Bern, Universität Bern

Purpose: Patients undergoing joint preserving hip surgery sometimes present damage on the ligamentum capitis femoris (LCF), the fovea capitis (FC) and the fossa acetabuli (FA). However, the prevalence of these lesions in early hip osteoarthritis is not known. In contrast to arthroscopy, surgical hip dislocation allows a full evaluation of these structures. The purpose of this study was to describe the damage pattern and the prevalence of lesions of the LCF, FC and the FA in patients undergoing surgical hip dislocation with a new classification system.

Methods: Retrospective observation study; Evaluation of 653 consecutive cases of joint preserving surgery (2015-2019); Exclusion of patients with periacetabular osteotomy and hip arthroscopy. 82 hips with complete video-documentation included for final evaluation. The indication for surgical hip dislocation was combined cam-pincer-femoroacetabular impingement, torsional deformities, avascular necrosis, Perthes deformities and posttraumatic disorders. The mean age at surgery was 27 ± 6,8 years (17-46). After performing the trochanteric osteotomy and capsulotomy, the femur was decoapted with a bone hook in order to access the pyramidal structure of the ligamentum capitis femoris. After transection and resection of the ligament, the FC and the FA were systematically video-documented with the femoral head in full dislocation. The assessment of the damage was performed with a newly proposed classification system.

Results: 77 (94%) hips presented damage of the LCF, the FC and/or the FA. (1) 68 (83%) hips showed damage of the LCF, 45 (55%) presented a pathological ligament structure, 24 (29%) a partial- and 2 (2%) a total rupture. (2) Degenerative lesions of the FC were documented in 43 (52%) hips. (3) 64 (78%) showed lesions of the FA. Central osteophytes were observed in 16 (20%) hips. Lesions of the LCF, the FC and the FA are highly prevalent in patients undergoing surgical hip dislocation. Therefore, they should be considered since they could have an impact on postoperative outcome and pain.

FM57

Femoroacetabular impingement morphology unremarkably increases the risk for osteoarthritis in a young population with a mean follow-up of 43 years *(8162)*

Dr. Armando Hoch; Dr. Pascal Schen; Dr. Thorsten Jentzsch; Dr. Stefan Rahm; PD Dr. Patrick Zingg

Universistätsklinik Balgrist

Introduction: The mechanical conflict in symptomatic femoroacetabular impingement can lead to early osteoarthritis of the hip. However, radiographic impingement morphology of the hip is often seen in individuals

without the clinical picture of symptomatic femoroacetabular impingement. Long-term observation regarding the risk for developing osteoarthritis with asymptomatic impingement morphology of the hip is lacking.

Material and methods: We radiographically and clinically investigated 51 (32 male, 19 female) patients who had a radiograph of the hip, including AP pelvis and Dunn view, with a minimum follow-up of 25 years. On the index radiograph, the alpha angle in the AP pelvis and in the Dunn view, femoral torsion in the Dunn view, lateral center edge angle, cross-over sign, posterior wall sign, and the prominence of ischial spine sign in the AP pelvis view were determined. On the follow-up radiographs, osteoarthritis was classified according to Kellgren and Lawrence. Tegner Score regarding the index presentation was evaluated retrospectively. Harris Hip Score and WOMAC Score were assessed at latest follow-up.

Results: The mean follow-up was 43 years (range 25 – 58 years). Cam impingement morphology with high alpha angles of ≥ 55° on AP pelvis and Dunn view were associated risk factors and showed an odds ratio of 1.05 (p=0.002) and 1.10 (p=0.001) for developing or progression of osteoarthritis. Abnormal femoral torsion and acetabular retroversion (cross-over sign, posterior wall sign, prominence of ischial spine sign) were not risk factors for osteoarthritis. Patients activities reflected by the Tegner Score at index presentation showed a tendency to be an associated risk factor (p=0.051).

Conclusion: This study showed that asymptomatic cam impingement morphology in young patients raises the risk for developing or progression of hip osteoarthritis by five to ten percent in a long-term follow-up with a mean of 43 years, thus its contribution was surprisingly small.

FM58

Application of pelvic binders in unstable pelvic ring fractures – are guidelines followed in daily practice? *(8175)*

Valerie Kuner[1]; PD Dr. Frank J.P. Beeres[1]; Dr. Jürgen Fornaro[2]; Dr. Michael Stickel[3]; Stephanie Studer[4]; Prof. Dr. Matthias Knobe[1]; Prof. Dr. Reto Babst[1]; PD Dr. Björn-Christian Link[1]

[1] Department of Orthopaedic and Trauma Surgery, Cantonal Hospital Lucerne; [2] Department of Radiology, Cantonal Hospital Lucerne; [3] Department of Emergency Care, Cantonal Hospital Lucerne; [4] Medical University of Zurich

Background: Application of a pelvic binder (PB) in patients with pelvic ring fractures may reduce pelvic volume and restrict interfragmentary motion. This aims to limit blood loss. Therefore, according to current trauma guidelines, e.g. Advanced Trauma Life Support protocol, early administration of PB for suspected pelvic trauma is recommended. With this study, we evaluated the prevalence of a PB in high-energy pelvic fractures in patients assigned to the resuscitation room of a Level I trauma center in Switzerland. Furthermore, the correct application of a PB was assessed.

Methods: All patients assigned to the resuscitation room of the Lucerne Cantonal Hospital were evaluated between 2016 and 2017. Patients with a high-energy pelvic fractures that received a whole-body computer tomography (CT) were included. Fractures were classified according to Tile. Unstable fractures were defined as Tile B1, B3, C1, C2 or C3. Presence and position of a PB were assessed on CT. The position of the PB was scored to be correct if it covered both greater trochanters in total. Acceptable position was defined if the PB covered the greater trochanters partly. Incorrect position was defined if the PB did not cover the greater trochanters at all.

Results: Seven hundred and thirty patients were treated in the resuscitation room in 2016 and 2017 of whom 82 (11%) patients had a pelvic fracture. Five patients were excluded due to subacute or fragility fractures. Of the evaluated 77 patients, 26 (34%) had a PB in place. Eighteen (23%) patients had an unstable fracture pattern of whom 10 (56%) had received a PB. In all patients with PB, it was correctly placed in 4 (15%) cases, acceptable in 12 (46%) and incorrect in 10 (38%). In patients with unstable fractures, PB position was correct in 1 (10%) patient, acceptable in 7 (70%) patients and incorrect in 2 (20%).

Conclusion: Only one third of patients with pelvic fractures assigned to the resuscitation room had a PB placed. Moreover, of these, 38% of PB were adjusted incorrectly. Remarkably, half of patients with unstable pelvic fractures did either not receive a PB or had it positioned inadequately. These results clearly show that preclinical and clinical education programs on when and how to apply a PB should be improved.

FM59

The potential role of radiostereometric analysis to assess the stability of pelvic ring disruptions *(8183)*

Dr. Andreas Ladurner[1]; Dr. Stuart Callary[1]; Prof. Dr. Mark Rickman[1]; Prof. Dr. Dominic Thewlis[2]; Prof. Dr. Lucian Bogdan Solomon[1]

[1] Royal Adelaide Hospital; [2] The University of Adelaide

Introduction: Accurate data on fracture displacement during weight bearing in the rehabilitation of pelvic ring injuries are lacking. The aim of this study was to use radiostereometric analysis (RSA) to investigate the stability of surgically treated type C1 pelvic ring injuries upon immediate unrestricted weight bearing.

Materials and methods: Six patients with a type C1 pelvic ring injury stabilized by posterior plating and an anterior external fixator were investigated. Post-operatively, patients were instructed to mobilize weight bearing as tolerated. The external fixators were removed at six weeks. Patients were reviewed at 2, 4, 6, 12, 26, 52 and 104 weeks. Progress and complications were recorded including use of the Iowa Pelvic Score (IPS). Fracture stability was assessed on plain radiographs and by RSA.

Results: All patients progressed to full weight bearing without support within 6 weeks after surgery. The IPS was excellent in four patients and good and fair in one patient at the 104 weeks follow-up. On plain radiographs, all fractures appeared well reduced and no loss of reduction could be identified over time. By contrast, RSA showed some degree of fracture migration over time in all cases, with one case showing a three-dimensional migration of 10mm. The patient with the highest migration had the lowest IPS. In two patients RSA detected acute migration of 2mm when the external fixator was removed. This was not associated with any change in patient symptoms. RSA also demonstrated movements above the currently defined normal threshold through the 'un-injured' sacroiliac joint in two patients, suggesting a subtle C2 injury, missed at initial presentation and assessment.

Conclusion: This study demonstrates the limitations of plain radiographs in assessing pelvic fracture stability and migration during healing, and the potential of RSA in monitoring the effects of weight bearing on fracture stability.

FM60

The impact of mal-angulated femoral rotational osteotomies on the sagittal mechanical leg axis: a computer simulation model *(8185)*

Dr. Lukas Jud; Dr. Octavian Andronic; PD Dr. Lazaros Vlachopoulos; PD Dr. Sandro F. Fucentese; PD Dr. Patrick Zingg

Balgrist University Hospital

Introduction: Alteration of the postoperative mechanical leg axis is a known problem in femoral rotational osteotomies. However, not only the maintenance of the frontal mechanical leg axis seems important in such procedures, but also the maintenance of the sagittal mechanical leg axis. Goal of this study was to investigate the impact of femoral rotational osteotomies on the sagittal mechanical leg axis. Due to the difficult nature of these procedures, it was likewise the objective of this study to identify the degree of mal-angulation of the osteotomy planes that alter the postoperative sagittal alignment relevantly.

Methods: Using a computer simulation approach with 3D bone models of two patients with a pathologic femoral torsion (Model 1 with 42° antetorsion, Model 2 with 6° retrotorsion), subtrochanteric and supracondylar rotational osteotomies were simulated first with an osteotomy plane perpendicular to the mechanical femoral axis (baseline osteotomy plane) and second with predefined mal-angulated osteotomy planes. Subsequently to the osteotomies, five different degrees of rotation were applied and the postoperative deviations of the sagittal mechanical leg axes were measured.

Results: 420 simulations were performed. Using the baseline osteotomy plane, the postoperative sagittal mechanical leg axis changed by 0.4° ± 0.5° over both models. Using the mal-angulated osteotomy planes, maximum deviation of the postoperative sagittal mechanical leg axis of 4.0° ± 1.2° and 11.0° ± 2.0° was observed with 30° mal-angulation in the frontal plane and 30° of rotation for subtrochanteric and for

supracondylar procedures, respectively. A relevant postoperative deviation of more than 2° was already observed with mal-angulation of 10° in the frontal plane and 15° of rotation in supracondylar procedures.

Conclusion: Relevant changes of the postoperative sagittal mechanical leg axis could be observed in femoral rotational osteotomies with solely 5° of mal-angulation of the osteotomy planes. However, osteotomies perpendicular to the femoral mechanical axis showed no relevant alterations. To prevent problems in later required surgical treatments around the hip and knee, accurate preoperative planning is mandatory and surgical navigation aids should probably be considered. This applies in particular for supracondylar procedures and in cases with higher degrees of rotation.

FM61

Isolated Mobile Component Exchange In The Management Of Dual Mobility Cup Intra-Prosthetic Dislocation: Is It An Option? *(8210)*

Prof. Dr Julien Wegrzyn[1]; Dr Matthieu Malatray; Dr Vincent Pibarot; Prof. Dr Jacques Béjui-Hugues

[1] CHUV Cente Hospitalier Universitaire Vaudois

Intraprosthetic dislocation (IPD) is a specific complication of dual mobility cups (DMC). However, no previous studies have described the optimal strategy to manage long-term wear-related IPD, particularly when a DMC is not loose. This study aimed to (1) determine the prevalence of IPD and the macroscopic findings at the time of revision and (2) evaluate if isolated mobile component exchange could be an option to manage IPD occurring with a well-fixed DMC metal-shell.

From 1991 to 2009, a continuous series of 5274 THAs with DMC were prospectively enrolled in our institutional total joint registry. A cementless, hemispherical DMC was systematically implanted, regardless of the patient's age or indication for THA. At the latest follow-up, the registry was queried to isolate each occurrence of IPD, which was retrospectively analyzed regarding the patient's demographics, indication for THA, radiographs, intraoperative findings (polyethylene wear and lesion patterns on the mobile component, periarticular metallosis, and implant damage due to intraprosthetic impingement of the femoral neck), management of IPD (isolated exchange of the mobile component or DMC revision), and outcome.

At a mean follow-up of 14 years (3-26), 169 IPD (3.2%) were reported, with a meantime from THA of 18 years (13-22). IPD occurred predominantly in younger men ($p < 0.001$), but was not influenced by the indication for THA ($p=0.9$). In all patients with IPD, a macroscopic analysis of the explanted mobile component revealed circumferential polyethylene wear and damage to the chamfer and retentive area, with subsequent loss of retaining power for the femoral head. 16 IPD (9%) were associated with aseptic loosening of the DMC and were managed with acetabular revision, without recurrence at a mean follow-up of 7.5 years (5-11). 153 IPD (91%) were pure, related to wear of the mobile component chamfer and retentive area, and managed with isolated mobile component exchange. IPD recurred in 9 patients (6%) at a mean follow-up of 3 years (2-4.5). Additionally, severe premature polyethylene wear of the mobile component with DMC loosening occurred in 19 patients (12%) at a mean follow-up of 1.5 years (0.5-3).

A failure rate of 18% was reported within 5 years after isolated mobile exchange to manage IPD occurring with a well-fixed DMC metal-shell. Acetabular revision with synovectomy should remain the standard procedure to manage IPD, particularly if periarticular metallosis is present.

FM62

Outcome, failure modes and survivorship of 675 metal-on-metal hip replacements: a comparative epidemiology of hip resurfacing versus large head total hip at an 11-year mean follow-up *(8230)*

Dr Michele Palazzuolo; Ines Tornare; Dr Julien Stanovici; Dr Leilani Delaune; Dr Alexander Antoniadis; Prof. Dr Julien Wegrzyn

CHUV - Centre hospitalier universitaire vaudois

Introduction: Differences in outcome, failure modes and survivorship between metal-on-metal (MoM) hip resurfacing (RHA) and large head total hip arthroplasty (THA) are unclear. Indeed, comparative clinical series with consistent mid- to long-term follow-up remain sparse. This study aimed to (1) identify and compare the outcome and failure modes of MoM RHA and THA, and (2) compare the survivorship between these 2 groups.

Methods: Between 1998 and 2011, 675 MoM hip replacements (532 THA, 143 RHA) were prospectively included in our institutional total joint registry and retrospectively analyzed at latest follow-up. The most common failure modes for MoM RHA and THA were reported as MoM specific (i.e.; ARMD: Adverse Reaction to Metal Debris, ALVAL: Aseptic Lymphocyte-dominated Vasculitis-associated Lesions, and painful hip) or MoM non-specific (i.e.; fracture, infection, dislocation, and aseptic loosening). Revision for any reason was considered as the failure endpoint. Then, comparative survivorship analyses according to the mode of failure (i.e. MoM specific or non-specific) were performed. Time-survivorship Spearman correlations were performed in both groups. Fisher's exact test was used to assess non-random associations between two categorical variables. Log-rank tests were used to compare survivorship between the groups.

Results: At an 11-year mean follow-up (8-18 years), the rate of MoM specific failure was significantly higher in THA compared to RHA (13.5% vs 9.1%, OR 1.56, $p=0.04$) as well as the rate of MoM non-specific failure (3.2% vs 2.1%, OR 1.54, $p=0.04$). Particularly, the rate of ARMD was significantly higher in THA compared to RHA (9.0% vs 4.2%, OR 2.1, $p=0.02$). THA global survivorship was significantly lower than global survivorship for RHA at 10 years (90.5% vs 95.8%; $p < 0.001$) and 18 years (83.4% vs 88.8%; $p < 0.001$). Regarding both the MoM specific and non-specific failure modes, the 10-year survivorship was significantly lower in THA compared to RHA (95.0% vs 99.1%; $p < 0.001$ and 96.5% vs 99.1%; $p < 0.001$, respectively).

Conclusion: The 10-year survivorship of MoM hip replacement was significantly higher in RHA compared to THA. The causes for revision were intrinsically different between RHA and MoM THA. Particularly, the ARMD rate was significantly higher in MoM THA. Fretting corrosion at the head-neck junction (i.e.; trunnionnosis) may contribute to the higher ARMD rates and poorer survivorship of MoM THA when compared to RHA.

FM63

How does Total Hip Arthroplasty Dislocation influence Diagnostic Puncture Results *(8236)*

Dr. Henrik Bäcker[1]; Dr. John Richards; Prof. Dr. Carsten Perka; Dr. Sebastian Hardt; PD Dr. Viktor Janz

[1] Luzerner Kantonsspital Luzern

Introduction: In cases of total hip arthroplasty (THA) dislocation a synovial fluid aspiration is performed to confirm or exclude periprosthetic joint infection (PJI). It is currently unclear if dislocation of a THA influences synovial white blood cell (WBC) count and polymorphonuclear percentage (PMN%). It was the primary aim of this study to investigate the influence of THA-dislocation on WBC count and PMN%.

Method: Patients who underwent a synovial aspiration of a THA between 2015 and 2019 were identified over our arthroplasty registry and included in this prospective case-control study. Patients with a THA-dislocation and synovial hip aspiration were matched against patients, without THA dislocation, undergoing hip aspiration prior to aseptic THA revision surgery, and patients undergoing hip aspiration prior to septic THA revision surgery. A total of 84 patients, 28 for each of the three subcohorts, were included in this study. The mean age in the THA dislocation group was 74.3 years, compared to 73.3 years in the aseptic THA revision and 75.8 years in the septic THA revision group. Matching criteria included gender, year of puncture (±2 years) and age (±5 years). Study endpoints were synovial WBC count, PMN%, synovial erythrocyte count as well as serum CRP-levels.

Results: Synovial WBC count was significantly increased in the THA dislocation vs. aseptic THA revision group ($p= 0.015$), as well as between the septic THA revision group vs. dislocation and aseptic THA revision group (both $p < 0.001$). The PMN% did not differ significantly between the THA dislocation and aseptic THA revision groups ($p= 0.294$), whereas for the septic THA revision group vs. THA dislocation and aseptic THA revision groups significant differences were observed ($p < 0.001$). The synovial erythrocyte count was increased in the dislocation group and septic THA revision group vs. the aseptic THA revision group ($p= 0.153$ vs. $p= 0.09$). Mean serum CRP-values were 12.4 ±14.9mg/dl

in THA dislocation, 24.1 ±37.7mg/dl in the aseptic THA revision group compared to 85.7±84.9mg/dl in the septic THA revision group (p <0.001).

Conclusion: This study shows that THA dislocation lead to an increase in synovial WBC count, while PMN% was unaffected. Cut-off values for the diagnosis of PJI in synovial fluid should be interpreted with caution after THA dislocation and new thresholds should be developed for HA dislocation or minimal open biopsy should be prioritized to exclude infection.

FM65

Screw-blade fixation systems in proximal femur fractures: a biomechanical evaluation. *(8300)*

Dr. Clemens Schopper[1]; Katharina Keck[1]; PD Dr. Frank Beeres[2]; PD Dr. Björn-Christian Link[2]; Prof. Dr. Reto Babst[2]; PD Dr. Sven Nebelung[3]; Dr. Ivan Zderic[1]; Prof. Dr. Boyko Gueorguiev[1]; Prof. Dr. Matthias Knobe[2]

[1] AO Research Institute Davos; [2] Luzerner Kantonsspital; [3] RWTH Aachen University

Introduction: There is an on-going development of novel fixation systems in order to reduce mechanical complication rates after osteosynthesis of proximal femoral fractures. These include systems combining screw and blade elements. The aim of this biomechanical study was to compare the fixation capability of the two currently available screw-blade fixation systems. It was tested if the Rotationally stable Screw-Anchor (RoSA) was superior to the Gamma3 RC Lag Screw (U-Blade) regarding failure loads and stiffness. Additionally, we investigated the influence of implant mal-positioning on the implants' behavior.

Methods: Twenty pairs of human cadaveric femoral heads were divided in four groups (n = 10). Both implants were inserted both centrally and eccentrically in the femoral heads. The bone-implant-constructs were exposed to cyclic axial loading with a rate of 2 Hz. Starting at 1000 N, the peak load was increased by 0,1 N per cycle until construct failure occurred. Statistical analysis was performed at a level of significance of 0.05 for all tests.

Results: Centrally inserted, the mean failure load for the RoSA was 2707 N (SD 926 N) and 4255 N (SD 1005 N) for the U-Blade (p = .033). In off-center position, the RoSA reached mean failure loads of 2835 N (SD 623 N) and the U-Blade 2476 (SD 885) (p = .224). The change from center to off-center position lead to a decrease in failure loads for the U-Blade (p <.001), while there was no difference in failure loads for the RoSA (p = 1.000). The predominant failure mode in the center groups was varus collapse (varus collapse vs. rotation failure: RoSA: 7 vs. 1, U-Blade: 5 vs. 3), whereas the specimens in the off-center groups mainly failed due to rotation around the implant axis (varus collapse vs. rotation failure: RoSA: 8 vs. 1, U-Blade: 9 vs. 0). The initial stiffness was 1402 N/mm (SD 228 N/mm) for the RoSA and 1254 N/mm (SD 143 N/mm) for the U-Blade in the center groups (p = .088). In the off-center groups, the RoSA showed an initial stiffness of 1250 N/mm (SD 450/mm) and the U-Blade of 843 N/mm (SD 227 N/mm) (p = .009).

Conclusions: In this study, the U-Blade proved to be the stronger implant in the central implant position compared to the RoSA. On the other hand, the RoSA reacted less sensitive to the rotational moments arising from the off-center position and therefore, seems to provide higher rotational stability.

FM66

Could a Simple Screening Procedure Identify Patients with Early Cognitive Impairment? Implications for The Treatment of Geriatric Femoral Neck Fractures *(8307)*

Dr. Andreas Flury; Dr. Michael Finsterwald; Dr. Dimitris Dimitriou; Dr. Julian Hasler; Dr. Alexander Antoniadis; PD Dr. Näder Helmy

Background: Current evidence suggests that cognitive capacities in patients who sustain a femoral neck fracture (FNF) correlate to patient outcome. Identifying patients who are best treated with a total hip arthroplasty (THA) to reduce overall complications remains a challenge. To investigate patients cognitive function is time consuming and therefore rarely performed preoperatively. We hypothesized that a simple selection procedure with two questions: "Can you perform your groceries independently?" and "Can you prepare your daily medications unassisted?", which imply a certain level of physical and cognitive function, could identify patients with early cognitive impairment and as a result influence the outcome of hip arthroplasty following a FNF.

Methods: At our clinic, the selection procedure was introduced in 2012 to simplify decision-making in geriatric FNF. At the time of surgery, patients received a THA when able to perform their grocery shopping and prepare their daily medications unassisted (n=100); otherwise, a HA was performed (n=100). The postoperative complications, short- and long-term mortality were assessed retrospectively. Second, we prospectively investigated whether patients inability to perform groceries or prepare medications was associated with the presence of early cognitive impairment, tested with the Consortium to Establish a Registry for Alzheimer's Disease-Neuropsychological Assessment Battery (CERAD-NAB).

Results: The screening questions showed almost perfect agreement (k = 0.8; sensitivity/specificity: 82%/95%; accuracy: 90%) to early cognitive impairment. The 30-day mortality for THA and HA patients was 2% and 4%, respectively. The 1-year and 5-year survivorship for the THA group was 95% and 87%, respectively, whereas the 1-year and 5-year survivorship for the HA group was 63% and 8%, respectively. Revision and complication rates were comparable.

Conclusion: The results might suggest that two simple screening questions could help in the decision making of the appropriate surgical treatment in elderly patients suffering from a displaced FNF.

FM67

Long-term follow-up of patients undergoing the modified Dunn procedure for slipped capital femoral epiphysis *(8311)*

Dr Caroline Passaplan; Prof. Dr Emanuel Gautier

HFR - hôpital fribourgeois

Introduction: The modified Dunn procedure is a well known option to restore the hip anatomy and to avoid further complications in patients with slipped capital femoral epiphysis (SCFE). Long-term data on clinical outcomes remain sparse, but some studies described a low rate of osteoarthritis and avascular necrosis at long-term follow-up by patients treated with a modified Dunn osteotomy. Our retrospective analysis reports the outcome of patients operated for slipped capital femoral epiphysis (SCFE) using the modified Dunn procedure. The results, the complications and the need for revision surgery are compared with the recent literature.

Methods: We retrospectively evaluated 18 patients (19 hips) who underwent the modified Dunn procedure for the treatment of SCFE. Outcome measurement included standardized scores. Clinical assessment included ambulation, leg length discrepancy, and hip mobility. Radiographically the quality of epiphyseal reduction was evaluated using the Southwick and Alpha-angles. Avascular necrosis, heterotopic bone formation and osteoarthritis were documented at follow-up.

Results: At a mean follow-up of nine years, the mean Merle d'Aubigné Score was 16.7 points, the modified HHS 91.1 points, the HOOS 89.2 points, and the UCLA Activity Score 8.7. Radiographically the mean slip angle improved from 31° to minus 6° after surgical correction, and on the axial view the Alpha-angle decreased from 92.9° to 37.4°. One patient developed an AVN; one patient already had an AVN at the time of delayed diagnosis. Two hips developed slight osteoarthritic signs at 14 and 16 years after the index operation. Six patients needed a total of nine revision surgeries. One operation was needed for surgically induced lateral hip subluxation, one for secondary displacement and implant failure, two for late FAI (4 and 16 years), one for FAI of the opposite hip (at 5 years), and four for implant removal.

Conclusion: Our series shows good results and is comparable to previous published studies. The modified Dunn procedure allows the repositioning of the slipped epiphysis. Long-term results with subjective and objective hip function are superior, development of OA and AVN inferior to other reported treatment modalities. Nevertheless, the procedure is technically demanding and revision surgery for secondary FAI and implant removal are frequent.

FM68

Periprosthetic Acetabular Fractures in the Elderly: Survival and Complication Rates Compared to Other Types of Hip Fractures in this Population *(8341)*

Vera Stetzelberger[1]; Dr. Iris F Brouze[1]; PD Dr. Simon Damian Steppacher[2]; Prof. Dr. Moritz Tannast[1]

[1] Cantonal hospital Fribourg, University of Fribourg; [2] Inselspital Bern, Universität Bern

Purpose: Periprosthetic acetabular fractures in the elderly are rare compared to other fractures of the hip. Nevertheless, their incidence is increasing due to an aging population with yearly growing numbers of total hip arthroplasties (THA). In contrast to other fractures of the hip, these fractures remain underreported in the current literature. Surgical reconstruction is complex, is often highly invasive for a patient with significant comorbidities and implies weight bearing restrictions. One would expect that the one-year mortality should be higher than in other fractures of the hip. However, the mortality rate of periprosthetic acetabular fractures in the elderly has never been assessed. Therefore, the aims of this study were: (1) to evaluate one-year mortality rate after operative treatment; (2) to assess the perioperative complication rate (3) to compare our results with the published literature of periprosthetic femur fractures, acetabular and proximal femur fractures in the elderly patient.

Methods: Retrospective comparative study. Identification of 136 consecutive surgically treated acetabular fractures in elderly patients (2012-2019). Level-1 Trauma center. Exclusion criteria: Non-periprosthetic, Age <60, conservative treatment, malignancy induced pathological fractures. 37 cases available for final evaluation. 6 (16%) occurred perioperatively. 11 (30%) patients treated with open reduction internal fixation (ORIF), 26 (70%) with revision THA and additional ORIF. (1) All patients were contacted and one-year mortality was assessed with Kaplan-Meier survivorship analysis. (2) The perioperative complication rate was extracted from patients electronic medical records. (3) The Pubmed/Medline database was used to collect mortality data for periprosthetic proximal femur fractures, acetabular and proximal femur fractures in the elderly.

Results: (1) Two (5%) patients died within one postoperative year, none of the deaths occurred in-hospital. (2) 20 (54%) patients had perioperative complications, most commonly an anemia requiring transfusion in 18 (49%) cases. (3) One-year mortality after periprosthetic proximal femur fractures ranged from 10 to 17%, compared to 15 to 33% after acetabular fractures and 9 to 40% after proximal femur fractures. Although the operative treatment of periprosthetic acetabular fractures in the elderly is complex and requires extensive surgery, the one-year mortality is surprisingly lower than for other fractures of the hip.

FM69

Do High Impact Sport Promote Proximal Femoral Pathomorphology During The Growth Spurt? – Results Of A Longitudinal Prospective Study *(8348)*

Dr. Markus Simon Hanke[1]; Dr. Florian Schmaranzer[2]; Dr. Simon D Steppacher[2]; Dr. Stefan F Werlen[3]; Prof. Dr. Klaus A Siebenrock

[1] Inselspital Universitätsspital Bern; [2] Inselspital Bern, Universtität Bern; [3] Sonnenhof - Lindenhofgruppe

Introduction: Femoroacetabular impingement (FAI) is a leading cause for pain and early osteoarthritis in the young patient and can be differentiated in cam FAI and pincer FAI. Young men typically present with an aspherical extension of the epiphyseal scar, which is referred to as "idiopathic" cam deformity. Preliminary studies have suggested that the alteration of the epiphyseal growth plate may be triggered by high-impact sporting activities (e.g. ice hockey, basketball). However, longitudinal studies assessing the influence of high impact sport on epiphyseal growth are lacking. The purpose of this study was to compare the proximal femoral anatomy before and after the growth spurt of young boys playing ice hockey on a competitive level.

Methods: We report the results of a longitudinal, prospective study involving 25 boys (25 hips) playing ice hockey on the highest national level of their age. All children underwent native MRI of the hip at baseline, 1.5-year follow-up and 3-year follow-up. We assessed the proximal femoral anatomy on radial proton density images around the "clock-face": epiphyseal angle, epiphyseal tilt angle, epiphyseal extension and alpha angle. To compare the changes for the different time points and each measurement (baseline vs. 1.5-year follow-up vs. 3-year follow-up) paired Student's t-test was used.

Results: We found increasing values at the anterior and anterosuperior portion of the femoral head comparing the baseline MRI to the 3-year follow-up for the alpha angle (e.g. 2 o'clock position: baseline: 45° ± 7; 3-year follow-up: 58° ± 10; p-value: <0.001). On the other hand decreasing values for the epiphyseal angle (e.g. 2 o'clock position: baseline: 76° ± 7; 3-year follow-up: 71° ± 8; p-value: 0.002) and epiphyseal tilt angle (e.g. 1 o'clock position: baseline: -12° ± 5; 3-year follow-up: -17° ± 5; p-value: <0.001) at the anterosuperior portion of the femoral head at latest follow-up. At baseline, 8% of the hip presented an alpha angle >60°, this value increased to 54% at 3-year follow-up (p-value: <0.001).

Conclusions: In young ice hockey players, cam deformities develop during skeletal maturation. By adjusting athletic activities during a small period of skeletal growth, the formation of a cam deformity might be prevented.

FM70

Cutibacterium avidum resists surgical skin antisepsis in the groin: A potential risk factor for periprosthetic joint infections *(8392)*

Steven M. Maurer[1]; Laura Kursawe[2]; PD Dr. Stefan Rahm[3]; Prof. Dr. Annelies S. Zinkernagel[1]; PD Dr. Annette Moter[2]; PD Dr. Stefan P. Kuster[1]; Prof. Dr. Reinhard Zbinden[4]; PD Dr. Patrick Zingg[3]; PD Dr. Yvonne Achermann[1]

[1] University Hospital Zurich; [2] Charité-Universitätsmedizin Berlin; [3] University Hospital Balgrist; [4] University of Zurich

Introduction: The skin commensal Cutibacterium avidum has been recognized as an emerging pathogen in hip arthroplasty, causing periprosthetic joint infections (PJI). In the current paradigm, skin commensals contaminate the peri-implant tissue during surgery. We addressed whether standard skin antisepsis before total hip arthroplasty (THA) is effective to eliminate colonizing bacteria with focus on C. avidum.

Methods: In a single-center, prospective study, we screened all patients for skin bacteria in the groin with swabs within 2 weeks before THA. In patients colonized with C. avidum, we preoperatively repeated skin swabs after the first and third skin antisepsis. In addition, we intraoperatively took dermis biopsies for microbiology and fluorescence in situ hybridization (FISH).

Results: Fifty-one out of 60 patients (85%) with a median age of 67 years were colonized with any bacteria before surgery, mainly with coagulase-negative staphylococci (78.3%) and C. avidum (20%). After routine single-shot antibiotic prophylaxis and intraoperative skin antisepsis in 10 patients, we still detected growing bacteria in 5 (50%) and C. avidum in 2 (20%) patients, respectively. Dermis biopsies were all culture negative but FISH detected single positive ribosome-rich C. avidum in one case near sweat glands.

Conclusion: Facultative pathogenic skin colonizing bacteria, including C. avidum, resist preoperative skin antisepsis and systemic antibiotic prophylaxis. Colonization with these pathogens may thus increase the risk of contamination of the peri-implant tissue when implanting a THA. New and more effective techniques to improve skin antisepsis are urgently needed.

FM72

Postoperative comparison of muscle atrophy and fatty degeneration following posterior surgical approach in THA *(8420)*

Dr. Grigorios Svarnas; Dr. Filippo Pierobon; Dr. Laurençon Jonathan; Prof. Dr. Moritz Tannast

Hôpital cantonal Fribourg

Background: Total hip arthroplasty is the gold standard for treatment of hip osteoarthritis. The different surgical approaches utilize different intermuscular and internervous intervals to access the hip joint. Concerns have been expressed that the posterior surgical approach (Moore/Southern) causes soft tissue trauma resulting in post-operative muscle weakness of patients undergoing this procedure. We therefore asked whether the implantation of total hip prosthesis by this approach leads to (i) atrophy (decreased muscle diameter or cross-sectional area [CSA]) and (ii) degeneration (fatty infiltration) of 18 evaluated periarticular hip

muscles and if yes, if there is an approach-related pattern of muscle degeneration.

Materials and methods: We retrospectively evaluated 100 consecutive patients undergoing computed tomography of the pelvis in our hospital between 2018 and 2019 with a THA at any given time earlier in their life. Trauma, metastasis, bone tumor, neurologic disorder, infection and revision cases were excluded. We evaluated muscle diameter, CSA (cross sectional area) and degree of fatty infiltration according to Goutallier for 18 periarticular hip muscles on axial and sagittal views and compared it as well with the contralateral non-operated side.

Results: Post-operative muscle diameter and CSA of the evaluated hip muscles did differ. There was a statistically significant difference in muscle degeneration in the operated hips operated by posterior approach according to the Goutallier classification notably for the external rotator group (goutalier II-IV).

Conclusion: The posterior hip approach for total hip arthroplasty leaves consistently signs of muscle degeneration of the external hip rotators postoperatively, as evaluated on postoperative CT scans.

FM73

A Reduced Coverage of the Anterior Acetabular Wall Is Associated with Higher Conversion Rates to Total Hip Arthroplasty in Patients after Periacetabular Osteotomy *(8470)*

Vera Stetzelberger[1]; PD Dr. Simon Damian Steppacher[2]; Dr. Till Dominic Lerch[2]; Prof. Dr. Klaus Arno Siebenrock[2]; Prof. Dr. Moritz Tannast[1]

[1] Hôpital cantonal fribourgeois, University of Fribourg; [2] Inselspital Bern, University of Bern

Achieving the reconstruction of an adequate postoperative anterior and posterior coverage is mandatory for a good postoperative outcome and long-term survival after periacetabular osteotomy (PAO). However, quantification of anterior and posterior coverage is difficult in clinical practice (especially intraoperatively) and require either computed tomography or specialized time-consuming software analysis. As an alternative, the anterior and posterior wall indexes (AWI/PWI) were introduced which are simple to measure on standardized anteroposterior pelvis radiographs and highly reproducible. The aim of this study was to evaluate if the wall index is a negative predictive factor for conversion to total hip arthroplasty after long-term outcome of PAO.

Methods: Retrospective therapeutic study. Evaluation of 63 (75) patients who received PAO for hip dysplasia (1984-1987). Minimum follow-up 27 years. Endpoints were defined as conversion to THA, progression of osteoarthritis and Merlé d'Aubigné Score <15. Exclusion of patients with Perthes deformities and other severe morphological acetabular abnormalities, as well as missing or poor quality radiographs. 58 hips (51 patients) included in final evaluation. Postoperative anteroposterior pelvis radiographs of all cases were reviewed with digital measurements of the anterior and posterior wall indices. Cox-regression analysis was performed to evaluate if AWI or PWI are predictors for failure.

Results: The cox-regression analysis showed that a severely reduced AWI (<0.1) is a predictive factor for conversion to THA (p <0.001; HR 5.5 [2.6-11.5 95% CI]). It was also associated to a poor outcome (progression of osteoarthritis and/or a Merle d'Aubigné score <15) (p <0.001; HR 4.3 [2.0-9.0 95% CI]).

Conclusion: An AWI <0.1 suggesting an extremely reduced anterior acetabular coverage is associated with a higher conversion rate to THA in patients who underwent PAO for acetabular dysplasia. Therefore, assessing the AWI could help for the intraoperative balancing of the acetabulum during PAO.

FM74

Comparison of the primary stability of porous titanium and porous tantalum acetabular components (acetabular cup and augment) *(8495)*

PD Dr. Nicholas A. Beckmann[1]; Prof. Dr. Rudi G. Bitsch[2]; Prof. Dr. Klaus-Arno Siebenrock[1]; Mareike Schonhoff[3]; Dr. Sebastian Jäger[3]

[1] Inselspital Bern, University of Bern; [2] Deutsches Gelenkzentrum Heidelberg; [3] Klinik für Orthopädie und Unfallchirurgie, Universitätsklinikum Heidelberg

Introduction: International literature has shown that total hip arthroplasty is becoming more and more frequent, as are the subsequent revision procedures. Porous implants have been designed to address this, and improve revision results through enhanced osseointegration in comparison to more traditional implants. The fixation between the augment and cup has been shown to have a significant influence on the stability of the implant construct (augment and cup) in the bone. It has been unclear, however, what relevance the material of the implant plays in the stability of the implant/bone fixation. The goal of this study is to evaluate a porous cup and augment made of titanium and compare it to a porous tantalum cup and augment, in order to discern any differences in the fixation stability within the construct as well as with the bone.

Methods: Two groups of 6 composite hemipelvises with a Paprosky IIb defect were treated with a porous multi-hole cup and corresponding 1cm augment. The first group received titanium components (Gription, DePuy Synthes) whereas the second received tantalum (Trabecular Metal, Zimmer Biomet). The cups and augments were fixed to the pelvis and respective implant component in a standardized manner. Both the cups and augments were affixed to the bone using 2 screws each; the implant components were cemented to each other. The implanted hemipelvises were then cyclically loaded to 3 load levels (0.5kN, 0.9kN and 1.8kN), corresponding to 30%, 50% and 100% load of an 80kg individual during normal walking. The relative motion of the components and bone to each other was determined using an optical measuring device, and the results subsequently statistically evaluated descriptively and using a T-Test and repeated measures ANOVA.

Results: There was a significant difference in the relative motion of the implant relative to the bone in the two groups, particularly at higher load. Furthermore, the amount of load applied had a significant influence on the relative motion of the implant to the bone (bone/augment: $F(2, 16) = 352.66$, $p < 0.001$)(bone/cup: $F(2, 16) = 331.96$, $p < 0.001$), but not within the implant construct (cup/augment: $F(2, 16) = 2.87$, $p = 0.086$).

Conclusion: Both implant materials displayed low relative motion in the evaluated scenario, particularly at lower loads. At higher loads (100%) the tantalum construct displays less relative motion with the bone. Clinical correlation of this data is required.

FM75-FM98: KNEE

FM75

Combined correction of tibial torsion and tibial tuberosity-trochlear groove distance by supratuberositary torsional osteotomy of the tibia *(8186)*

Dr. Lukas Jud[1]; Dr. Sarvpreet Singh[1]; Dr. Timo Tondelli[1]; Prof. Dr. Philipp Fürnstahl[2]; PD Dr. Sandro F. Fucentese[1]; PD Dr. Lazaros Vlachopoulos[1]

[1] Balgrist University Hospital; [2] Balgrist CARD

Introduction: Increased external tibial torsion and increased tibial tuberosity-trochlear groove distance (TTTG) are two factors associated with patellofemoral disorders. Rotational osteotomy of the tibia and transfer of the tibial tuberosity are established surgical treatment options. Less attention has been paid to the combined correction of tibial torsion and TTTG by supratuberositary osteotomy so far. Goal of this study was to quantify the effect of a supratuberositary rotational osteotomy on TTTG.

Methods: All patients who underwent supratuberositary rotation osteotomy due to patellofemoral instability from October 2017 to April 2019 were included. Using 3D surface models, supratuberositary rotational osteotomies were simulated with predefined degrees of rotation. 3D TTTG was measured for every degree of rotation by a novel and validated measurement method. Additionally, all patients were radiographically evaluated using conventional 2D measurement techniques in pre- and postoperative CT scans.

Results: A total of seven patients was included with a mean external tibial torsion of 34.7° ± 8.0° and mean 2D, respectively, 3D TTTG measurements of 19.8 mm ± 2.5 mm and 20.0 mm ± 2.4 mm. Supratuberositary rotational osteotomy with a mean tibial rotation of 10.8° ± 5.6° resulted in a postoperative 2D, respectively, 3D TTTG of 13.6 mm ± 3.8 mm and 14.6 mm ± 3.4. Additionally, 500 supratuberositary rotation osteotomies were simulated in all 7 operated and in additional 13 patient models (n = 20), whereby the linear regression estimate yielded a change of -0.68 mm in 3D TTTG per degree of tibial rotation.

Conclusion: In supratuberositary osteotomy, TTTG correction can be predicted by the degree of tibial rotation. Hence, tibial torsional deformity and TTTG can be corrected by one single osteotomy in selected cases.

FM76

The Deep Lateral Femoral Notch Sign: A Reliable Diagnostic Tool in Identifying a Concomitant Anterior Cruciate and Anterolateral Ligament Injury *(8198)*

Dimitris Dimitriou[1]; Dr. Matthias Reimond; Dr. Andreas Foesel; Dr. Bodo Baumgaertner; PD Dr. Näder Helmy

[1] Bürgerspital Solothurn

Background: The diagnosis of a concomitant anterior cruciate ligament (ACL) and anterolateral ligament (ALL) injury could be extremely challenging.

Objective: To investigate the validity and reliability of the deep lateral femoral notch sign (DLFNS) in identifying a concomitant ACL/ALL injury, and predicting the clinical outcomes following an anatomical single-bundle ACL-reconstruction.

Methods: The lateral x-rays and MRI images of 100 patients with an ACL rupture and 100 control subjects were retrospectively reviewed. A receiver operator curve (ROC) analysis was performed to define the optimal cut-off value of the DLFNS for identifying a concomitant ACL/ALL injury. The relative risk (RR) was also calculated to determine whether the presence of the DLFNS was a risk factor for residual instability or graft failure following an ACL- reconstruction.

Results: The prevalence of DLFNS was 52% in the ACL-ruptured patients and 15% in the control group. A DLFNS>1.8 mm demonstrated a sensitivity of 89%, a specificity of 95%, NPV of 98%, and PPV of 89% in identifying a concomitant ACL/ALL injury. Patients with a DLFNS>1.8 mm, had 4.2 times increased risk for residual instability and ACL graft failure compared to patients with a DLFNS≤1.8 mm.

Conclusions: A DLFNS>1.8 mm could be a clinically relevant diagnostic tool for identifying a concomitant ACL/ALL injury with high sensitivity and PPV. Patients with a DLFNS>1.8 mm should be evaluated carefully for clinical and radiological signs of a concomitant ACL/ALL injury, and eventually treated, when necessary, with a combined intraarticular ACL reconstruction and extra-articular tenodesis to avoid a residual rotational instability and graft failure.

FM77

Anatomy of the Anterolateral Knee Ligament in Patients with and without an ACL-Rupture: Implications for Anatomical Anterolateral Ligament Reconstruction *(8199)*

Dimitris Dimitriou[1]; Prof. Dr. Tsung-Yuan Tsai; PD Dr. Näder Helmy

[1] Bürgerspital Solothurn

Introduction: Anterior cruciate ligament (ACL) rupture is often accompanied by an injury to the anterolateral ligament (ALL) of the knee. Recently, there is an increasing interest in combined ACL / ALL reconstruction due to better clinical outcomes reported, compared to the isolated ACL-reconstruction. Detailed knowledge of the ALL attachments in ACL-ruptured patients is essential for an anatomical ALL reconstruction to avoid knee over-constraint and successfully treat the residual rotational instability.

Materials and methods: In the present, retrospective case - control study, the magnetic resonance images of 90 knees with an ACL- rupture and 90 matched-controlled subjects, who suffered a non-contact knee injury without an ACL- rupture, were used to create three-dimensional models of the knee. The femoral and tibial ALL footprints were outlined on each model, and their position was measured using an anatomical coordinate system.

Results: The femoral origin of the ALL was located 4.9 ± 2.8 mm posterior and 3.8 ± 2.4mm proximal to the lateral epicondyle in a non-isometric location in control subjects. In ACL-ruptured patients, it was located in a more posterior and distal, at 6.0 ± 1.9 mm posterior and 2.4 ± 1.7 mm proximal to the lateral epicondyle ($p < 0.01$), also in a non-isometric location. The tibial insertion of the ALL was located at about 60% the distance between the Gerdy tubercle (GT) /fibula head (FH) from the FH in and about 7.0 mm from the lateral tibial plateau in both groups ($p > 0.05$).

Discussion: The femoral ALL origin was significantly different in ACL-ruptured patients compared to ACL- intact patients. The recommended femoral tunnel position for the anatomical ALL reconstruction, which is based on anatomical studies in ACL- intact knees, does not represent the femoral ALL origin in the ACL- ruptured knee. The results of the present study might constitute a new insight into the ALL attachment positions, which could assist surgeons who perform anatomical ALL-reconstructions.

FM78

Do women and men have different outcomes 1 year after bicondylar total knee arthroplasty (TKA)? – Analysis of treatment effects, symptom scores and willingness to do surgery again in a large single center cohort *(8240)*

Dr. Jörg Huber[1]; Franziska Beyer[2]; Prof. Dr. Jörg Lützner[2]

[1] Stadtspital Triemli Zürich; [2] Universität Carl Gustav Carus Dresden

Introduction: Gender differences were found in femoral condyle morphology and lead to the development of "gender" adapted implants. In a met-analysis no clinical benefit of gender-specific TKA implants could be found (Cheng 2014). However, a gender difference was found for myocardial infarction: more symptom localizations in women (Lawesson 2018) and delayed treatment in women (Meyer 2019). With this study, we wanted to analyze gender differences for symptom intensity, the 1-year treatment effects and willingness to do the surgery again.

Methods: The study was performed with a University-based arthroplasty registry. Included were all patients with primary bicondylar TKA for osteoarthritis; excluded polyarthritis, unicondylar TKA, constraint TKA, revision, neoplasia, infection, no agreement. All patients received a cemented bicondylar TKA without patellar resurfacing. All patients had assessment with patient questionnaires (Oxford Knee score; OKS) before and one year after TKA. 1 year postoperatively the patients were asked about their willingness to do the surgery again (yes, probably yes, unsure, probably not, not)

Statistical analysis: For each patient the treatment effect was calculated using the OKS (TE = symptom reduction/baseline symptoms). Descriptive statistics were used to determine the variability of scores for both genders and the rates for willingness to do the surgery again.

Results: We could include 583 patients treated with unilateral TKA from 01/2013 to 12/2017 with a complete 1 year follow up; 313 women (53.7%) and 270 men. The mean age at surgery was 68.7 years from 39.1 to 87.7 years old. The treatment effects ranged from 1 to -0.62 with a mean average treatment effect of 0.56; for women 0.56 (SD 0.28) and for men 0.57 (SD 0.34) with no significant difference. The mean OKS scores preop to postop ameliorated for women from 20.8 to 35.9 and men from 23.6 to 37.6 with a significant gender difference at baseline and 1 year follow up ($p < 0.05$). The rates of willingness to do the surgery again were significantly lower for women 80.4% (men 89.1%; $p < 0.006$).

Conclusion: In this large single center registry, the treatment effects for bicondylar TKA were equal for both genders. But there were significant higher mean symptom scores (OKS) for women also pre- and postoperatively. The rate of willingness to do the surgery again is significantly higher in men.

FM79

1-Year Treatment Effects for Bicondylar Total Knee Arthroplasty in a Large Single Center Cohort *(8242)*

Dr. Jörg Huber[1]; Prof. Dr. Jörg Lützner[2]; Franziska Beyer[2]

[1] Stadtspital Triemli Zürich; [2] Universität Carl Gustav Carus Dresden

Introduction: The treatment effect (TE) is a newer method to measure the change after treatment. The TE is calculated as number: TE = symptom reduction/baseline symptoms. A positive score means amelioration, 0 staying unchanged and a negative score worsening; the best score is 1 meaning a patient without symptoms after treatment. In this study the 1 year TE's for bicondylar TKA were calculated in a large cohort and separated in 5 outcome groups.

Methods: The registry data of a single-unit university based arthroplasty center were used. All patients with primary bicondylar TKA for osteoarthritis were included; excluded were: polyarthritis, unicondylar knee arthroplasty, constraint TKA, revision, neoplasia, infection, no agreement to participate. All patients received a cemented bicondylar TKA without patellar resurfacing. All patients had assessment with patient questionnaires (Oxford Knee Score) before and one year after surgery. For each patient the treatment effect (TE) was calculated using the OKS. Descriptive statistics were used to determine the variability of scores before and after TKA. The cohort was separated in 5 outcome groups. Excellent: TE >0.95, good TE >0.5 to 0.95, moderate TE >0.2 to 0.5, unchanged TE 0.2 to -0.2 and worse <-0.2.

Results: From 01/2013 to 12/2017, 913 patients in the registry received TKA thereof 771 had bicondylar TKA. 189 were excluded during follow up leaving 582 patients for analysis. 312 women (53.7%), the average age was 68.7 years, the mean BMI was 30.9 kg/m2 and 47.8% had serious comorbidities (ASA 3 and 4). The mean OKS improved significant from mean 22.1 points (SD 6.8) to 36.7 points (SD 8.5) (p <0.001). The TE's ranged from 1 to -0.62 with a mean treatment effect of 0.56 (SD 0.31). The 5 outcome groups were: excellent 5.5%, good 57% and moderate 23.4%. 11.9% remained unchanged and 2.2% worse. 662 patients (=85.9%) responded to treatment (=excellent+good+moderate).

Conclusion: The treatment effect is a simple way to measure outcome with higher precision compared to "classic outcome". The 5 outcome categories are useful to describe the different qualitative outcomes. 85.9% of the patients responded to TKA; however 14.1% of the patients had no or even a negative treatment effect.

FM80

What is the Economic Impact of 5 different TKA Technologies? – a Multicentre Analysis *(8291)*

Dr. Bernhard Christen[1]; PD Dr. Max Ettinger[2]; PD Dr. Michel Bonnin[3]; PD Dr. Peter Koch[4]; PD Dr. Tilman Calliess[1]

[1] Articon Spezialpraxis für Gelenkchirurgie; [2] Orthopädie St. Annastift Hannover; [3] Santy Orthopaedic Centre; [4] Kantonsspital Winterthur (KSW)

Introduction: Over the past years different technologies for TKA implantation were introduced to enhance precision and accuracy of the procedure. They failed to significantly improve clinical outcome although newer data demonstrate that revision rates can be reduced by computer technology in the long term.

The goal of this multicentre study was to describe and analyse 5 different techniques used in European Centres.

Material and methods: In a prospective multicentre study all the peri- and intraoperative costs of a procedure including time for each step were analysed for 5 different TKA techniques and standardized for Switzerland: 1) Manual, 2) conventional navigated 3) CT-based, patient specific instruments (PSI), 4) Imageless robot-assisted und 5) CT-based robotarm-assisted TKA.

Results: The manual technique costs 12'983 CHF per TKA. The imageless computer navigation costs additionally 354 CHF for disposals 78 CHF for maintenance and 202 CHF for the additional operating time. PSI causes additional costs of 1.770 CHF for the preoperative CT scan and the PSI cutting jigs which is not compensated by reduction of OR time (-247 CHF) nor by less surgical trays. The imageless robot system induces costs for disposals and trays of +920 CHF, maintenance costs of 234 CHF and 748 CHF for additional operating time. The robotarm-assisted technique demands a preoperative CT scan, disposals and trays for 1900 CHF. Technical support is 1210 CHF, additional time for surgery is similar to computer navigation and counts for 288 CHF.

Discussion: The present study shows remarkable differences in costs comparing 5 different surgical procedures all being more expensive than a manual implantation of TKA. A detailed cost-effectiveness analysis including clinical results and risk for revision has to be performed for each surgical technique to enable a fully integrated economic perspective.

FM81

Cost-effectiveness of robotic arm-assisted TKA *(8292)*

PD Dr. Tilman Calliess; Dr. Bernhard Christen

Articon Spezialpraxis für Gelenkchirurgie

Introduction/Aim: The additional costs for robotic arm-assisted TKA (RA-TKA) is 2'794 $ more expensive compared to manual standard procedure. In a second study the mean costs for a revision TKA were 45'250 $. The question of this study was if robotic arm-assisted TKA technology could save costs by reduction of early revision after primary TKA and/or improved quality of live for the patients.

Methods: The methodology is based on the Markov-Modell analyzing the costs per QALY (quality-adjusted life-years), which is a generic measure of disease burden. In literature, it has been used to assess the value for money of medical interventions. Basic assumption is, that cost per additional QALY of less than 58'000 $ are cost-effective for the community. In our calculation, the prior evaluated costs for TKA, RA-TKA and Revision-TKA are included. The actual demographics and numbers for TKA and age-adjusted revision rate are derived from of the Swiss Implant Register (SIRIS). Data regarding the life-quality is taken from the Swedish Knee Arthroplasty Register. The influence of following variables were evaluated regarding the cost-effectiveness: hospital volume, patient age, reduction of revision rate, and improvement of life-quality compared to standard TKA.

Results: Even a maximum imaginable reduction of the revision rate in TKA by up to 66% within the first 2 years and 36% afterwards does not lead to an economic benefit of the RA-TKA. The QALY improvement per case is calculated with +0.004 points in the best-case scenario (high volume unit and young female patient), still resulting in a value of 213'562 $ per additional QALY. Taking the life-quality as the variable, the analysis shows, that a slight additional QALY improvement is necessary to achieve cost-effectiveness. This can be achieved if the amount of unikondylar knee (UKA) is increased by only 3% in young male and up to 40% in old men.

Conclusion: Our analysis shows, that improving the patients' quality of life has a much larger impact on cost-effectiveness of technology used to implant knee prosthesis, than has the sole reduction of revision rate. As a larger amount of UKA is the easiest way to achieve higher quality of life in today's patient collective, the main goal for robotic-assisted knee arthroplasty is to make this operation safer and to get better confidence for the surgeon to increase the rate of UKA.

FM82

The effect of a distal femoral varus osteotomy on patellar stabilization: A 3D computer-simulation of the q-angle with a novel measurement method *(8306)*

Dr. Andreas Flury; Dr. Lukas Jud; Dr. Armando Hoch; Dr. Roland Camenzind; PD Dr. Sandro Fucentese

Purpose: The effect of a distal femur varization osteotomy on patellofemoral mechanics in genu valgum is unknown. The purpose of this study was to quantify the influence of frontal leg axis on the q-angle with a novel 3-dimensional (3-D) measurement method and to assess tibial tuberosity-trochlear groove (TT-TG) distance.

Methods: 3-D surface models of the lower extremities were generated using patients computed tomography (CT) data. The preoperative 3-D q-angle was measured using a novel defined and validated 3-D measurement method. Then, biplanar supracondylar osteotomies were simulated with different degrees of varus correction (1° to 15°) in one-degree steps of the preoperative valgus deformity, resulting in a total of 150 simulations. Additionally, mechanical leg axis and 3-D q-angle measurements were performed on 3-D surface models of the postoperative CT scans of the same individuals. Further, pre- and postoperative TT-TG distance was measured.

Results: Mean native q-angle was 15.8 ±3.9° (range, 10-21.4°) with a mean preoperative mechanical leg axis of 6.5°±2.4 valgus (range, 3.8-11.6° valgus). The q-angle changed steadily 0.95 ±0.02° per 1° of varization. No difference was detected between values derived from simulation to postoperative 3D q-angle measurement (p=0.638). TT-TG distance changes irregularly and minimally, mainly due to an unintentional component of rotation (malpositioning or loss of correction) during surgery.

Conclusion: Distal femur varus osteotomy has an effect on the q-angle similar to medialization of the tibial tubercle. The clinical relevance of this study is that combined distal femoral osteotomy in genu valgum is a suitable treatment option for patellar instability.

FM83

Surgical Outcomes and Analysis of Quality of Life Following Knee Arthroplasty in Patients Exceeded the Estimated Life Expectancy *(8308)*

Dr. Linda Wild; Dr. Andreas Fösel; Dr. Stephan Radzanowski; Dr. Michael Grabherr; PD Dr. Näder Helmy; Dr. Dimitris Dimitriou

Bürgerspital Solothurn

Introduction: In an aging population the incidence of severe knee osteoarthritis in very elderly patients increases, leading to functional impairment and loss of independence. Knee replacement could be an effective treatment but is often denied due to fear of increased complication rate with advanced age. The objective of this study was to investigate complication rate, mortality, clinical outcome and quality adjusted life years (QALY) of primary knee replacement in patients already exceeding the average life expectancy at time of surgery.

Methods: Medical records of 85 cases, receiving a primary total (TKA) or unicompartimental (UKA) knee replacement, aged 83 years or older at time of surgery, were retrospectively reviewed for surgical and medical complications as well as survivorship. Functional outcome was obtained by Oxford Knee Score (OKS) and QALY.

Results: At a mean follow-up of 16 months (TKA) and 18 months (UKA) surgical and medical complication rate was 11% and 8% for TKA and 4% and 4% for UKA, respectively. Overall 30-days and 1-year mortality was 1.2% and 2.4%. 5-year survival rate was 83.1% (TKA) and 86.6% (UKA). OKS improved from 19 to 41 points in TKA and from 23 to 40 points in UKA. Mean quality-adjusted life years were 4.1 years for TKA and 3.9 years for UKA.

Conclusion: TKA and UKA are safe and reliable surgical procedures in the treatment of end-stage osteoarthritis in very elderly patients. Patients benefit from improved pain, function and quality of life. The mortality rate is low and the overall complication rate is acceptable, although slightly higher than reported in younger cohorts. If the patient is suitable, UKA should be preferred over TKA as the complication rate is significantly lower. Patients should not be excluded from knee replacement based on their age alone, but careful patient selection, peri- and postoperative optimization and awareness for complications are quintessential for successful treatment.

FM84

Short-term outcome of a modern fixed bearing rotating hinge prosthesis in complex primary total knee arthroplasty *(8330)*

Dr. Andreas Hecker; Hans-Jürg Alexander Pütz; Dr. Emanuel Liechti; Prof. Frank Michael Klenke

Insel Spital Bern

Introduction: Hinged prosthesis marked the beginning of knee arthroplasty but led to early loosening and implant failure due to the high level of constraint. Modern rotating hinge knee prostheses (RHKP) transfer most of the load through the tibio-femoral articulation and use the hinge mechanism only for stabilization, thereby decreasing the risk of early mechanical failure. Introduced for total knee arthroplasty (TKA) revision, RHKP are used increasingly for complex primary TKA. However, outcome data of primary TKA with modern rotating hinge designs is scarce. Therefore, this study aimed at investigating early functional and radiographic results after primary TKA using a rotating hinge knee, newly introduced in 2012.

Methods: We retrospectively reviewed our hospital database between July 2015 and August 2019. Of 116 implanted rotation hinge prosthesis (Medacta, GMK Hinge), 35 were implanted in primary cases. 13 patients (mean age 71(55-86) years) with 14 primary implantations had a minimum follow-up of two years (2.0 – 3.4 years). One patient with paraplegia was excluded. In the remaining 13 knees data from radiographic follow-up, clinical examination and postoperative outcome scores (2011 Knee Society Score (KSS), Hospital for Special Surgery Score (HSS), Oxford Knee Score (OKS) and EQ-5D-3L) were analyzed.

Results: The main indication for using this prosthesis were combinations of instability (n=8), severe coronal plane deformity (n=7), flexion deformity (n=6) and rheumatoid arthritis (n=5). The mean postoperative range of motion was 122° (90-140°). The mean HSS was 84/100, the KSS was 96/100 (objective measurements), 32/40 (satisfaction), 11/15 (expectation) and 59/100 (activity) and the mean OKS was 26. None of the patients showed radiographic signs of loosening at the final follow-up. Implant survival was 100%. The only documented knee related complication was a postoperative hematoma treated with needle aspiration.

Conclusion: The short-term results of this rotating hinge total knee system are promising and show good objective and subjective outcome data. The fair activity level has to be interpreted against the background of elderly patients with co-morbidities. No early loosening occurred and no revision surgery was necessary. Implantation of such a prosthesis in complex primary cases seems to be a safe procedure for patients with severe deformity or instability. Long-term follow-up with larger cohorts is warranted to further evaluate this implant.

FM85

Ecological Momentary Assessment in Knee Osteoarthritis: an Effective Method to Avoid Bias in Documenting Symptoms *(8357)*

Dr. Davide Previtali; Dr. Marco Cuzzolin; PD Dr. Marco Delcogliano; Dr. Luca Deabate; Dr. Giuseppe Filardo; Prof. Dr. Christian Candrian

EOC (Ente Ospedaliero Cantonale) - Ospedale Regionale di Lugano

Introduction. The most used method to evaluate the outcome in the field of knee osteoarthritis is based on questionnaires referred to the previous weeks. However, the retrospective evaluation of symptoms may be highly biased by the limited capability of the patients to recall his experience. The "Ecological Momentary Assessment" has been introduced to allow a better, complete and affordable evaluation of the symptoms of the patients with knee osteoarthritis.

Methods. Fifty patients with symptomatic knee osteoarthritis use a mobile application for their smartphones to daily report their knee symptoms (pain, function) with a 0-10 numeric rating scale for 8 weeks. Two follow-up visits, at 4 and 8 weeks, are performed. The patient is asked to retrospectively quantify knee symptoms (pain, function) suffered in the previous months on a 0-10 numeric rating scale. The mean of the daily assessment of symptoms is compared with the retrospective evaluation of the patient. The correlation between the documented difference (mean of the daily assessment - retrospective assessment) and patients and symptoms characteristics is evaluated.

Results. Twenty-one patients have been enrolled until now. The first month follow-up have been completed by 17 patients, 3 did not used the mobile application correctly, 1 is under assessment. The difference between the mean daily evaluation and the retrospective assessment is -0.7 on the 0-10 pain numeric rating scale and is statistically significant ($p = 0.02$), whereas it is not statistically significant on the 0-10 function numeric rating scale. The difference for the numeric rating scale correlates with the intensity of pain ($p = 0.02$) and the number of pain peaks ($p = 0.05$) during the past month. Six patients had a constant pain, defined by the presence of less than 2 peaks, whereas 15 patients suffered inconstant pain.

Conclusion. The use of mobile applications for smartphones allows a correct and reliable evaluation of patient symptoms. In particular it limits the risk of bias of the retrospective evaluation that may affect the clinical evaluation of the patients in the clinical practice and weaken the results in the research field of knee osteoarthritis.

FM86

Independent Drilling versus Transtibial Approach in Anterior Cruciate Ligament Reconstruction: A Meta-analysis with Meta-regression *(8358)*

Dr Marco Cuzzolin; PD Dr Marco Delcogliano; Dr Luca Deabate; Dr Davide Previtali; Dr Giuseppe Filardo; Prof. Dr Christian Candrian

EOC (Ente Ospadaliero Cantonale) - Ospedale Regionale di Lugano

Introduction: Anterior cruciate ligament (ACL) reconstruction can be performed with different techniques of independent and transtibial drilling of femoral tunnels but there is still not a clear consensus on which approach leads to the best clinical, radiological, and biomechanical outcomes. The aim of the present meta-analysis of randomized controlled trials was to quantitatively synthetize the best literature evidence comparing independent and transtibial femoral approaches, during ACL reconstruction.

Methods: A systematic literature search was conducted on 07.01.2020 using PubMed, Web of Science, Cochrane library and Scopus literature databases. Influence of different techniques of femoral drilling was analysed through meta-analyses in terms of patient reported outcome measures, risk of complications, range of motion limitation, graft failures, and differential laxity. Sub-analysis was performed to assess the best independent drilling technique used among the considered. A linear meta-regression was performed to evaluate if the year of publication reported in the studies influenced the results. Risk of bias and quality of evidence were assessed following the Cochrane guidelines.

Results: A total of twenty-two randomized control trials were included in the meta-analysis. Both International Knee Documentation Committee (IKDC) subjective and Lysholm scores were found significantly improved with the independent drilling approach (MD=0.54, p=0.005; MD=1.24, p=0.02). No difference was documented in terms of risk of re-injury but independent drilling reduced anterior tibial translation with the KT-1000 examination (mean difference, -0.23, CI 95%, p=0.01) and denoted a higher probability of post-operative negative pivot shift test (risk ratio=1.13, p=0.04). There were no significant differences in IKDC objective scores or Tegner scores between groups.

Conclusions: This meta-analysis of RCTs documented that independent femoral tunnel drilling provides better clinical outcomes than the transtibial approach, without increased risk of re-injury. Among the different independent drilling options, anteromedial seems to provide the most favourable results. The meta-regression showed increasingly better results with the independent drilling techniques in the last years, suggesting the importance of a learning curve to ensure the optimal results for the treatment of ACL tears.

FM87

The Long-lasting Effects of "Placebo Injections" in Knee Osteoarthritis: A Meta-analysis *(8367)*

Dr. Davide Previtali; Giorgio Di Laura Frattura; PD Dr. Marco Delcogliano; Dr. Luca Deabate; Dr. Giuseppe Filardo; Prof. Dr. Christian Candrian

EOC (Ente Ospadaliero Cantonale) - Ospedale Regionale di Lugano

Introduction. Knee osteoarthritis is one of the most common incapacitating diseases, frequently managed with intra-articular injections. A placebo effect of knee injections has been suggested by studies on saline, but its impact beyond short-term pain modulation remains to be understood. The aim of this meta-analysis is to quantify the placebo effect of intra-articular injections for knee osteoarthritis in terms of pain, function, and objective outcomes. Factors influencing the placebo effect were also investigated.

Methods. Meta-analysis of randomized controlled trials (RCTs); Level of evidence, 2. PubMed, Web of Science, Cochrane Library, and grey literature databases were searched on 08th of January 2020 using the string: (knee) AND (osteoarthritis OR OA) AND (injections OR intra-articular) AND (saline OR placebo). The following inclusion criteria were used: double-blind, randomized controlled trials on knee osteoarthritis, including a placebo arm on saline injections. The primary outcome was pain variation. Risk of bias was assessed using the RoB 2.0 tool and quality of evidence graded following the GRADE guidelines.

Results. Out of 2,363 records, 49 articles on 4,076 patients were included. The meta-analysis showed significant improvements up to the 6-month follow-up: VAS-pain -13.4MD (95%C.I.: -21.7/-5.1; p <0.001), WOMAC-pain -3.3MD (95%C.I.: -3.9/-2.7; p <0.001). Other significant improvements were WOMAC-stiffness -1.1MD (95%C.I.: -1.6/-0.6; p <0.001), WOMAC-function -10.1MD (95%C.I.: -12.2/-8.0; p <0.001), and evaluator global assessment -21.4MD (95%C.I.: -29.2/-13.6; p <0.001). The responder rate was 52% (95%C.I.: 40%-63%). Improvements were greater than the "minimal clinically important difference" for all outcomes (except 6-month VAS-pain). The level of evidence was moderate for almost all outcomes.

Conclusion. The placebo effect of knee injections is significant, with functional improvements lasting even longer than those reported for pain perception. The high, long-lasting, and heterogeneous effects on the scales commonly used in clinical trials further highlight that the impact of placebo should not be overlooked in the research on and management of knee osteoarthritis.

FM88

Is punching an alternative to extraction drilling of femoral tunnels in press-fit anterior cruciate ligament reconstruction? *(8371)*

Dr. Janosch Häberli; Dr. Maximilian Heilgemeir; Sebastian Valet; Ameet Aiyangar; Tom Overes; Prof. Dr. Stefan Eggli

Introduction: Conventional press-fit (PF) techniques for anterior cruciate ligament (ACL) reconstruction involve extraction drilling of the femoral bone tunnel and manual shaping of the patellar bone plug. Disadvantages include bone loss with debris distribution within the knee joint, potential heat necrosis and metal wear debris due to abrasion of the guide wire. In order to overcome these disadvantages, a novel technique including punching of the femoral bone tunnel was introduced and its fixation strength tested in comparison to the gold standard interference screw (IS) fixation in porcine lower limbs. We hypothesised that press fit fixation with punched femoral tunnels is not inferior to IS-fixation and tested this hypothesis in three flexion angle configurations (0°/ 45°/ 90°).

Methods: Sixty skeletally mature porcine knees (30 pairs) were used. The ACL was reconstructed with a full thickness central third patellar tendon strip including a patellar bone cylinder 9.5 mm in diameter. One side of each pair was prepared with the PF-system and the other side was prepared with IS-fixation. An equal number of left and right sided samples were used for both fixation systems, respectively. Ten pairs of specimens were randomly assigned to one of three loading angles (0°, 45°, 90°) each. For mechanical testing, the diaphysis of the femur was fixed, while the free end of the tendon autograft was pulled quasi-statically (5 mm/s) until failure. A three-way multi-factor ANOVA analysis was carried out to investigate the influence of a) fixation type, b) flexion angle, c) side of the bone pair.

Results: Primary fixation strength of femoral press-fit graft fixation with punched femoral tunnels did not differ significantly from IS-fixation (p=0.5128), with mean loads of 422.4±134.6 N (n=28) and 445.4±135.8 N (n=25), respectively. The fixation strength was not significantly affected by the side of the bone pair (left/ right 0.7888). Only "flexion angle" had a substantial effect (p=0.0097) on the maximal load to failure, with highest loads in 45° configuration (503.4±141.2 N for PF-fixation and 488.6±157.8 N for IS-fixation, respectively).

Conclusion: Primary fixation strength of femoral press-fit graft fixation with punched femoral tunnels is equivalent to interference screw fixation. The procedure therefore represents a safe method for ACL reconstruction with patellar or quadriceps tendon autografts when a patellar bone plug is used.

FM89

PRP Injections for the Treatment of Knee Osteoarthritis: A Meta-analysis of Randomized Controlled Trials *(8378)*

Dr. Francesca Napoli[1]; Dr. Davide Previtali; Dr. Marco Delcogliano; Dr. Luca Deabate; Prof. Dr. Christian Candrian; Dr. Giuseppe Filardo

[1] EOC (Ente Ospedaliero Cantonale) - Ospedale Regionale di Lugano

Introduction: Promising results have stimulated physicians to include platelet-rich plasma (PRP) in clinical practice for managing knee osteoarthritis. However, the effectiveness of PRP remains controversial. The

aim of this study is to evaluate the effectiveness in terms of patient reported outcome measures of PRP injections for knee osteoarthritis compared to placebo and other intra-articular treatments.

Methods: To conduct this meta-analysis, PubMed, Cochrane Library, Scopus, Embase, Web of Science, as well as the grey literature, were searched on January 17th, 2020. Randomized controlled trials comparing PRP injections with placebo or other injective treatments, in any language, and on human were included. The risk of bias was assessed following the Cochrane guidelines; the quality of evidence was graded using the GRADE guidelines.

Results: 34 RCTs, on 1,403 knees in PRP groups and 1,426 in control groups, were included. WOMAC score favoured PRP, with a statistically and clinically significant difference vs placebo at the 12-month follow-up ($p = 0.02$) and vs HA at the 6-month ($p <0.001$) and 12-month ($p <0.001$) follow-ups. A clinically significant difference favouring PRP vs steroids was documented for VAS pain ($p <0.001$), KOOS pain ($p <0.001$), function in daily activities ($p = 0.001$) and quality of life ($p <0.001$) at the 6-month follow-up. However, the superiority of PRP did not reach the minimally clinical important difference for all outcomes, and the quality of evidence was low.

Conclusion: The effect of platelet concentrates goes beyond mere placebo effect, and PRP injections provide better results than other injective options. This benefit increases over time, becoming clinically significant at 12 months. However, although substantial, the improvement remains partial and supported by low quality of evidence. This finding urges further research to confirm benefits and identify the best indications for PRP injections in knee osteoarthritis.

FM90

Peri-operative steroids reduce acute pain and hospitalization length after knee arthroplasty with no increased risks: A meta-analysis. (8376)

Dr. Luca Deabate, Dr. Davide Previtali, Giorgio Di Laura Frattura, Dr. Marco Delcogliano, Dr. Giuseppe Filardo, Prof. Dr. Christian Candrian

EOC (Ente Ospedaliero Cantonale) - Ospedale Regionale di Lugano

Introduction: There is no consensus regarding the risks and benefits of peri-operative steroid supplementation in total knee arthroplasty (TKA). The aim of this meta-analysis is to compare protocols implemented with or without steroids after TKA in terms of pain, symptoms, inflammatory response, and hospitalization length.

Methods: A systematic literature search was performed on the 03.05.2019 on PubMed, Web Of Science, Cochrane library, and on the grey literature for a meta-analysis of RCTs comparing peri-operative analgesia protocols implemented with or without steroids. Sub-analyses considering the administration route, the steroid type, and the dosage were performed. Risk of bias and quality of evidence were defined according to the Cochrane guidelines.

Results: Nineteen articles were included. Steroid supplementation provides lower post-operative pain at day 1 ($p <0.001$), day 2 ($p = 0.003$), days 3-4 ($p = 0.006$), with less opioids consumption ($p = 0.05$), less nausea and vomit at day 1 ($p <0.001$) and day 2 ($p = 0.01$), with greater knee range of motion at day 1 ($p <0.001$), with shorter hospitalization length ($p = 0.01$) and lower C-reactive protein at day 1 ($p <0.001$), day 2 ($p = 0.05$), and days 3-4 ($p = 0.001$), with lower IL-6 at day 1 ($p <0.001$), day 2 ($p = 0.02$), and days 3-4 ($p = 0.04$), and with higher blood glucose at day 1 ($p = 0.004$). Non-significant differences were documented at longer follow-ups. Intravenous administration of 200 Steroid-Equivalents of a longacting steroid was associated with better results.

Conclusion: Steroid supplementation to peri-operative drug protocols is effective in decreasing postoperative pain, opioid consumption, nausea and vomit, range of motion limitation, and inflammatory markers without increasing complications. Although these benefits last only until day 4, steroid supplementation reduces the length of hospitalization after TKA.

FM91

Orthoplastics in Periprosthetic Joint Infection of the Knee: Treatment Concept for Composite Soft-tissue Defect and Extensor Apparatus Deficiency *(8488)*

Dr. Rik Osinga[1]; Dr. Maurice Eggimann[1]; Dr. Steven Lo[2]; Dr. Richard Kühl[1]; Dr. Alexander Lunger[1]; Prof. Dr. Peter Ochsner[3]; Prof. Dr. Parham Sendi[1]; Prof. Dr. Dirk Schaefer[1]; PD Dr. Martin Clauss[1]

[1] Universitätsspital Basel; [2] Glasgow Royal Infirmary; [3] Kantonsspital Baselland Standort Liestal

Introduction: Patients with periprosthetic joint infections (PJI) of the knee combined with soft-tissue defects and extensor apparatus deficiencies are a growing clinical problem. Treatment algorithms have been successfully proposed for PJI, but there is no published or uniformly accepted orthoplastic treatment protocol for PJI with a concomitant severe soft-tissue defect. We describe our technical approach from an orthoplastic surgeon's perspective as part of a multidisciplinary treatment concept for PJI of the knee. We focus on the reconstructive aspect of the extensor apparatus defect and review the available literature on this topic.

Methods: References through a PubMed search from January 1966 until November 2019 were identified.

Results: Five studies with a total of 17 patients were found. Only four patients underwent extensor apparatus reconstruction in addition to soft-tissue reconstruction around the knee. In our institution, we favour the principle to reconstruct tissue 'like with like', as this provides the best functional and aesthetic result. In case of a small soft-tissue defect and partial tendon loss, we use a free sensate extended lateral arm flap with triceps tendon. If the defect is larger with complete tendon loss, we use a free anterolateral thigh flap with fascia lata. In patients who do not qualify for free flap surgery, we use a pedicled medial sural artery perforator – gastrocnemius flap. Clinical examples are presented including long term functional outcomes.

Conclusion: The scarcity of literature indicates the need for a structured orthoplastic treatment concept. Here, we present our institution's treatment concept, which differentiates between various types of soft-tissue defects. We use either a free sensate extended lateral arm flap with triceps tendon, a free ALT flap with fascia lata or a pedicled MSAP gastrocnemius flap for soft-tissue reconstruction. These procedures should be performed as early as possible in a specialized bone and joint infection unit. Ideally, to maximize the time for the soft tissue to heal and integrate, during the first stage of orthopaedic treatment.

FM92

Influence of gait velocity on kinematic alterations of patients with knee osteoarthritis *(8529)*

Dr. Petros Ismailidis[1]; PD Dr. Christian Egloff[1]; Lea Hegglin[1]; PD Dr. Geert Pagenstert[2]; Dr. Rolf Kernen[3]; Prof. Dr. Anke Eckardt[4]; Prof. Dr. Thomas Ilchmann[4]; Prof. Dr. Annegret Mündermann[1]; Dr. Corina Nüesch[1]

[1] Universitätsspital Basel; [2] Praxis Clarahof; [3] Clara-Ortho; [4] Hirslanden Klinik Birshof, ENDO-Team

Introduction: Kinematic changes in patients with knee osteoarthritis (OA) have been extensively studied. Concerns have been raised whether the measured spatiotemporal and kinematic alterations are associated with disease progression or merely a result of reduced walking speed. The purpose of this study was to investigate the effect of walking speed on kinematic parameters in patients with knee OA using statistical parametric mapping (SPM).

Methods: Twenty-three patients with unilateral knee OA scheduled for a total knee replacement and 28 age matched control subjects were included in this study. Spatiotemporal parameters and sagittal plane kinematics were measured in the hip, knee, and ankle using the inertial sensors system RehaGait® while walking at a self-selected normal (patients and controls) and slow walking speed (controls) for a distance of 20 meters. Gait parameters were compared between groups for self-selected walking speeds and for matched walking speeds using SPM with independent sample t tests.

Results: At self-selected walking speed, patients had significantly lower knee flexion during stance (maximum difference, -6.8°) and during swing

(-11.0°), as well as higher ankle dorsiflexion during stance phase (+12.5°) and lower peak hip extension at the end of stance compared to controls (+4.2°). At matched speed, there were no significant differences in joint kinematics between groups.

Conclusion: Differences in sagittal plane gait kinematics between patients with knee OA and asymptomatic controls seem to be a result of reduced walking speed. These results emphasize the importance of considering walking speed in research on gait kinematics in patients with knee OA and in clinical trials using gait parameters as outcome measures.

FM93

A novel method for 2D/3D registration between non-weight-bearing 3D CT-reconstructed models and weight-bearing plain radiographs for preoperative planning in lower limb realignment surgery *(8531)*

Tabitha Roth[1]; Dr. Matthias Wieczorek[2]; Giulia Ceschi[3]; Dr. Wolfgang Wein[2]; PD Dr. Reto Sutter[4]; PD Dr. Sandro Fucentese[4]; Prof. Dr. Philipp Fürnstahl[5]

[1] Universitätsklinik Balgrist/ Balgrist Campus/ ETH Zürich; [2] ImFusion GmbH; [3] Universität Zürich; [4] Universistätsklinik Balgrist; [5] Balgrist Campus AG

Introduction: Deformity assessment and preoperative planning of realignment surgery is conventionally based on weight-bearing (WB) plain radiographs. However, newer technologies such as three-dimensional (3D) preoperative planning and surgical navigation by patient-specific instruments (PSI) rely on non-weight bearing (NWB) CT data. The tibiofemoral angle (TFA) is one of the most important parameters when planning high tibial osteotomies (HTO). It has been shown to be significantly different between WB and NWB data. We therefore present a novel computer method to calculate the WB position of the 3D models by considering the standing plain radiographs. Goal of the present study was to assess whether the TFA is significantly different between WB and NWB states.

Methods: 37 patients who underwent lower limb realignment surgery and had a full preoperative radiological dataset, including a biplanar standing long-leg radiograph and a CT scan, were included. A novel 2D/3D registration algorithm was developed in collaboration with ImFusion (München, Germany). The CT was aligned with the standing radiographs for femur and tibia separately, and the 3D models were subsequently brought into a WB position. The mechanical axes were then calculated and the TFA difference was assessed.

Results: Registration was successfully completed in all of the 37 cases, including patients with heavily deformed bones. Means of NWB and WB frontal alignment were significantly different (5.0 vs. 6.1° varus, $p = 0.01$). Mean absolute difference was 2.1° (range 0 – 7.6°), whereby 16.2% of all patients had an MAD of more than 4°.

Conclusions: Weight-bearing significantly influences frontal leg alignment and should therefore be considered when planning realignment surgeries of the lower extremity. 2D/3D registration using the proposed registration approach is a clinically feasible method to obtain weight-bearing 3D models and assess lower limb parameters in a loaded state.

FM94

Costs And Profits After Primary And Revision Knee Arthroplasty: A Financial Analysis *(8536)*

Dr. Sören Möller; Nora Gautschi; Dr. Daniele Gianoli; Prof. Dr. Klaus Möller; PD Dr. Karlmeinrad Giesinger

Introduction: The standard treatment for end-stage osteoarthritis is total knee arthroplasty (TKA) surgery. It is well established that primary TKA (pTKA) is highly cost effective but recent studies have shown revision TKA (rTKA) is far less profitable. In times of limited health care resources it seems important to investigate if the actual costs are covered by the different types of insurance coverage available in Switzerland. The aim of the study was to clarify the costs and profits of pTKA and rTKA and to investigate the effect of different types of insurance status on the financial outcome and Quality Adjusted Life Years (QALYs) gained at a large teaching hospital.

Methods: Data from the local TKA register of the Cantonal Hospital Saint Gallen were accessed and patients with pTKA and rTKA with completed EQ-5D scores were included. The costs, the revenues and the earnings were determined by the finance department for each patient and QALYs were generated using EQ-5D scores for one year after surgery. Finally the costs per QALY gained were calculated for pTKA and rTKA and a financial analysis regarding the insurance status was conducted.

Results: 1777 patients were treated with pTKA and 155 patients had revision surgery. The average costs per patient were 18.031 (pTKA) and 44.672 Euros (rTKA) respectively. On average 3.85 QALYs were gained in pTKA and 2.47 in rTKA. From 2013 to 2019 a generally insured patient receiving a pTKA at our institution accounted for an average loss of 941 Euros (SD +/- 5533) whereas a profit of 9421 (SD +/- 4246) and 13505 (SD +/- 5262) Euros could be gained for a semi-private and a private patient respectively. rTKA showed an average loss of 15040 Euros (general insurance) where in contrast a profit of 6191 and 15827 Euros was made with semi- and privately insured patients.

Conclusion: The costs for rTKA are substantially higher compared to primary TKA. The discrepancy of the financial loss between pTKA and rTKA in generally insured patients is challenging for large teaching centres. This loss can only be cross-financed with semi- and privately insured patients. The financial problem is aggrevated as complex primaries with severe comorbidities and rTKA are predominantly referred to large teaching centres.

FM95

Quality Adjusted Life Years And Cost Efficiency After Primary And Revision Total Knee Arthroplasty *(8538)*

Dr. Sören Möller; Nora Gautschi; Dr. Daniele Gianoli; Prof. Dr. Klaus Möller; PD Dr. Karlmeinrad Giesinger

Introduction: Total knee arthroplasty (TKA) is the standard treatment for end-stage knee osteoarthritis. It is well established that primary TKA (pTKA) is highly cost-effective. In times of limited health care resources revision TKA (rTKA) has come under administrative surveillance. Few studies have analysed the costs and clinical outcome of pTKA and rTKA. The aim of the study was to analyse the costs and patient reported outcomes for both procdures and compare the financial efficiency and the Quality Adjusted Life Years (QALYs).

Methods: A local TKA register from a large teaching centre in Switzerland was reviewed. Patients with pTKA and rTKA with completed EQ-5D scores and WOMAC osteoarthritis index questionnaires pre-op, at 2 month and 12 month post-op were included. Reasons for rTKA included infection, periprosthetic fractures, loosening, instability and chronic pain. Costs were provided by the finance department and data were merged with the register data. QALYs per procedure were calculated using the EQ-5D. Finally, the costs per QALY and costs per WOMAC point gained were calculated for pTKA and rTKA.

Results: Data from 1777 patients with pTKA and 155 patients with rTKA were analysed. The WOMAC osteoarthritis index improved by 41.4 points in primary TKA (pre-op 54.5, 12 month 13.1). In rTKA the improvement was 32.8 points (pre-op 52.4, 12 month 19.6). The average costs per patient were 18.031 Euros (pTKA) and 44.672 Euros (rTKA), respectively. On average, 3.85 QALYs were gained in primary TKA and 2.47 in rTKA. The costs per QALY gained were 4.681 Euros for pTKA and 18.220 Euros for rTKA. The WOMAC index points gained per costs showed similar results.

Conclusion: Both pTKA and rTKA are highly cost-effective with substantial patient improvement. The costs for rTKA are distinctly higher compared to pTKA and the costs per QALY gained are even more than 3 times higher compared to primary TKA. Similar results were shown for costs per WOMAC index point gained. These findings have important financial implications for an arthroplasty unit with regard to the case mix of patients.

FM96

Quantitative rehabilitation for knee osteoarthritis can induce specific changes in walking mechanics *(8547)*

Baptiste Ulrich[1]; Prof. Dr Brigitte M. Jolles[2]; Dr Julien Favre[1]

[1] Lausanne University Hospital and University of Lausanne (CHUV-UNIL); [2] Lausanne University Hospital and University of Lausanne (CHUV-UNIL); Ecole Polytechnique Fédérale de Lausanne (EPFL)

Quantitative rehabilitation methods using augmented reality and/or biofeedback have been recently proposed to treat knee osteoarthritis. They

aim at teaching new walking patterns to the patients in order to improve the loading environment at the knee. So far, for medial-compartment osteoarthritis, this has been done by reducing the peak value of the knee adduction moment during stance (pKAM), a variable reflecting the loading distribution between the medial and lateral compartments. The peak value of the knee flexion moment during stance (pKFM) has also been associated with knee loading, particularly with the total load applied to the joint. Consequently, in case of medial knee osteoarthritis, there is an interest in reducing the pKAM without increasing the pKFM. Today, it remains unclear if individuals can modify their walking patterns to induce such changes in knee kinetics. This study aimed at characterizing the feasibility of reducing the pKAM without increasing the pKFM through voluntary gait modifications.

Gait trials with modifications in foot progression angle, step width and stride length were recorded for 11 young healthy subjects (25 ± 5 years old; 21 ± 2 kg/m2) in a laboratory equipped with an augmented-reality system displaying instruction footprints on the floor. For each participant and modification, it was determined if a consensus target change, of at least 10% reduction in pKAM without increase in pKFM, was achieved.

All participants achieved the target kinetic change with at least one modification. Seven participants achieved it with modifications in foot progression angle, three participants with modifications in step width, and seven participants with modifications in stride length.

This study showed that it is feasible to reduce the pKAM without increasing the pKFM, therefore suggesting that, in the future, quantitative rehabilitation for patients with medial knee osteoarthritis could aim for more specific kinetic changes than simply pKAM reductions.

FM97

Collagen wrapping and local PRF do not improve the survival rates of ACL repair with dynamic intraligamentary stabilization. A retrospective study with a minimum follow-up of 5-years *(8554)*

Katharina Schürholz[1]; Dr. Emanuel Liechti[1]; PD Dr. Sandro Kohl[2]; Dr. Sufian Ahmad[3]; PD Dr. Frank Michael Klenke[1]

[1] Inselspital, Universitätsspital Bern; [2] Klinik Hirslanden Zürich; [3] BG Unfallklinik Tübingen

Introduction: In the last decade primary anterior cruciate ligament (ACL) repair has been reestablished as treatment principle for ACL tears. Techniques have been revised and several authors have advocated a potential role for primary repair techniques in the ACL decision tree. However, long-term results have been controversial. It was the purpose of the current study to determine the survival of the primarily repaired ACL after dynamic intraligamentary stabilization (DIS) with and without augmentation using a collagen fleece wrapping or platelet-rich fibrin (PRF).

Methods: Between July 2009 and February 2014, 117 patients with isolated acute ACL ruptures underwent DIS repair within 21 days (minimum 2, maximum 21 days) from injury and were available for final follow-up at least 5 years postoperatively. In 58 cases, DIS repair was augmented with a collagen fleece or PRF. Failure as endpoint was defined as conversion to ACL reconstruction, failure to restore stability with persisting laxity presenting ≥ 6 mm compared to the healthy side, traumatic rerupture, or loss of stability. Functional outcome was measured with the IKDC and Lysholm scores. Kaplan-Meier survival analysis was performed. Binary logistic regression was performed to identify factors influencing failure.

Results: Kaplan-Meier survival analysis demonstrated an overall survival of 0.69 (standard error S.E. 0.037) at 75 months follow-up. The application of collagen fleece wrapping or PRF did not improve survival rates. Survival without augmentation was 0.66 (S.E. 0.035) and 0.72 (S.E. 0.049) with augmentation (p=0.507). The one factor demonstrating a direct influence on failure after adjustment was a high pre-injury level of physical defined as a Tegner activity level of 7 or more. 94% of those patients with an intact ACL repair had normal or near normal knee function based on the IKDC scoring system; the subjective IKDC score was 89 ± 11 out of 100.

Conclusion: The mean survival rate after a minimum follow-up of 5 years following primary ACL repair using DIS was 69%. Wrapping of the ligament with a collagen fleece and the local application of PRF did not improve the success rate of ACL DIS repair. Patients not suffering failure of repair demonstrated good restoration of stability and high satisfaction. Nevertheless, the results of DIS repair in the present study are markedly inferior to those of established ACL reconstruction procedures.

FM98

The Need for Contralateral Total Knee Arthroplasty Depends on BMI *(8555)*

Matthieu Zingg; Dr Hermès Miozzari; Prof. Dr Didier Hannouche; Prof. Dr Anne Lübbeke

Hôpitaux Universitaires de Genève

Background: The number of obese patients has been growing for decades. Because of the strong correlation that exists between BMI and primary knee osteoarthritis, patients with high BMI frequently suffer from bilateral osteoarthritis and will be likely to require total knee arthroplasty (TKA) on both knees. This observation, although of major importance, has not been the subject of a dedicated study.

Objectives: The objective of this study was to determine the Incidence of contralateral TKA and time interval between the procedures as a function of BMI.

Design and methods: We conducted a prospective cohort study in a tertiary hospital including all primary TKA performed between April 1998 and March 2019. We compared the cumulative incidence of contralateral TKA in five different categories of BMI. We built Kaplan-Meier curves for all groups and compared unadjusted survival statistics using Log-rank test. We then used a competing risk regression model for death and to adjust for potential confounders.

Results: A total of 5,400 primary TKAs in 4,508 patients were included (mean age 71.5 years, 68% women). Mean follow-up was 7.6 years. 897 (19.9%) patients had a normal weight at the time of surgery, 1,643 (36.4%) were overweight, 1,209 (26.8%) were obese class I, 531 (11.8%) were obese class II and 228 (5.1%) were obese class III. Normal weight and overweight patients have a similar cumulative incidence of contralateral TKA and about 1/3 of those will have bilateral TKA. Obese class I, II and III demonstrate a significantly increasing incidence of contralateral TKA (log-rank test p <0.001). At 10 years after initial TKA, cumulative incidences of contralateral TKA by increasing BMI category were 28.9%, 28.2%, 32.5%, 41.3% et 48.2%. The competing risk subdistribution hazard ratios comparing obese class I, II and III vs normal/overweight were 1.2 (95%CI 1.0-1.4), 1.5 (95%CI 1.2-1.8) and 1.9 (95%CI 1.5-2.5), respectively.

Conclusion: We demonstrate a very strong influence of BMI on the incidence of contralateral TKA, where patients with a BMI ≥35 have more than a 40% chance of undergoing contralateral TKA during the ten years following the initial TKA. The probability to undergo contralateral TKA is 1.5 times higher in obese class II and twice as high in obese class III patients as compared to normal/overweight patients. This information is important for patients, surgeons and policy makers in order to establish future health needs required by obese patients.

FM99-FM112: FOOT

FM99

Supramalleolar Osteotomy in Posttraumatic Valgus Ankle Osteoarthritis *(8141)*

Dr. Nicola Krähenbühl[1]; Dr. Roman Susdorf; Prof. Dr. Alexej Barg; Prof. Dr. Beat Hintermann

[1] Kantonsspital Baselland

Introduction: Only limited evidence is available on mid- to long-term outcomes of patients treated with a supramalleolar osteotomy for posttraumatic valgus ankle osteoarthritis. The purpose of this study was to assess how the level of the deformity (supramalleolar versus intraarticular), the stage of the osteoarthritic process (joint space narrowing versus joint space obliteration), and the role of additional surgeries (fibula and calcaneal osteotomy) impact radiographic and clinical outcomes following a supramalleolar osteotomy for treatment of posttraumatic valgus ankle osteoarthritis.

Methods: Fifty-six (56) consecutive patients who underwent an extraarticular medial closing wedge osteotomy for posttraumatic valgus ankle osteoarthritis were included. Subgroups were formed according to the preoperative level of deformity and preoperative stage of ankle osteoarthritis. Additional surgical steps required to achieve a properly balanced hindfoot were also noted. Radiographic and clinical outcomes between subgroups were compared, and the role of any additional surgical step required to achieve a balanced hindfoot was investigated.

Results: Radiographic and clinical outcomes improved significantly between preoperative assessment and the last follow-up. Patients with a preoperative supramalleolar deformity showed superior radiographic outcomes compared to patients with an intraarticular deformity. Clinical outcomes did not differ significantly between these two subgroups. The preoperative stage of ankle osteoarthritis significantly impacted radiographic outcomes but did not influence clinical outcome measures. An additional fibula osteotomy was necessary for around a half of all patients, while a calcaneus osteotomy was needed for around a quarter of all patients. Both osteotomies were more frequently performed in patients with a preoperative intraarticular deformity. An overall low complication rate was evident. Four patients either underwent secondary total ankle replacement or an ankle fusion.

Conclusion: Overall, a supramalleolar osteotomy shows satisfactory mid- to long-term radiographic and clinical outcomes in patients with early- to mid-stage posttraumatic valgus ankle osteoarthritis. The radiographic outcome is highly dependent on the preoperative level of the deformity, while clinical outcome measures are not significantly impacted by preoperative deformities.

FM100

Posterior to Anterior Malleolar Extended Lateral Approach to the Ankle (PAMELA): A Cadaveric Anatomic Study *(8151)*

Dr Anne Kummer[1]; Dr Hugues Cadas[2]; Prof. Dr Xavier Crevoisier[1]

[1] CHUV; [2] UNIL

Introduction: The posterolateral approach is used in most cases of surgical treatment of ankle fractures involving the posterior and lateral malleoli. However, the posterolateral approach does not allow access to the anterolateral structures of the ankle, which represent important landmarks to allow an anatomical reduction in case of complex ankle fracture. Our objective is to propose a novel surgical approach for optimal management of injuries including both a fracture of the posterior malleolus and a complex lesion of the lateral and/or anterolateral portions of the ankle.

Methods: Cadaveric dissection, including a vascular study, was performed on eight specimens. Assessment included density of the vascular supply around the lateral malleolus, identification of the structures at risk, quality of exposure of the bony structures, and convenience of hardware fixation.

Results: The cutaneous flap benefits from a rich interconnected arterial supply. Structures at risk include the superficial peroneal and sural nerves, the lesser saphenous vein, and the peroneal artery. All are easily identified and protected during the procedure. The interval between the peroneal tendons and the flexor hallucis longus muscle provides optimal access to the posterior malleolus. The lateral malleolus is exposed by retracting the peroneal tendons medially. An anterolateral arthrotomy of the ankle, respecting the anterior talofibular and tibiofibular ligaments, offers a sharp view on the talo-tibio-fibular junction. Hardware placement can be done under direct visual control and perpendicular access to any exposed surfaces is provided.

Conclusions: The posterior to anterior malleolar extended lateral approach opens a new perspective in the optimal management of complex fractures of the ankle. The approach allows optimal exposure to address fractures of the posterior malleolus, of the lateral malleolus, and of the anterolateral portion of the ankle through a single incision. Application in clinical practice is the subject of another study in our institution.

FM101

Mid- to Long-Term Outcome in Patients Treated with a Mini-Open Sinus Tarsi Approach for Calcaneal Fractures *(8173)*

Dmitrijs Sidorenko; Dr. Nicola Krähenbühl[1]; Dr. Roman Susdorf; Dr. Roxa Ruiz; Prof. Dr. Beat Hintermann

[1] Kantonsspital Baselland

Introduction: While the extended lateral approach was the gold standard for treatment of calcaneal fractures for decades, the mini-open approach through the sinus-tarsi gained popularity in recent years. Although widely used, there are only a few reports available in the literature reporting on mid- to long-term results. Therefore, the purpose of the study was to report on mid- to long-term radiographic and clinical outcomes of calcaneal fractures treated surgically using a mini-open sinus-tarsi approach.

Methods: In this retrospective review, radiographic and clinical outcome measures of 30 consecutive patients (34 fractures) were analyzed. Conventional radiographs were used to measure the Boehler's angle before and after surgical fixation. Computed tomography (CT) scans were analyzed to distinguish between joint depression and tongue-type calcaneal fractures. Each calcaneal fracture was additionally categorized according to the Sanders classification. The clinical outcome was measured using a 5-point Likert scale ranging from 0 (very unsatisfied) to 4 (very satisfied), the Visual Analog Scale (VAS) for pain, and the Maryland Foot Score.

Results: The Boehler's angle improved from 12.6 degrees preoperatively to 26.3 degrees postoperatively ($P < 0.001$). Loss of sagittal reduction (i.e. a decline of the Boehler's angle of >5 degrees) from postoperative to the last follow-up was evident in nine (26%) fractures. Out of 29 patients with an available satisfaction score, 20 (69%) were very satisfied, 8 (28%) were satisfied, and one (3%) was moderately satisfied. Satisfaction at the last follow-up declined with higher age at surgery. An overall low complication rate was evident, with painful hardware needing removal being the most common complication. No patient underwent subtalar fusion during the follow-up period.

Conclusion: Approaching calcaneus fractures through the sinus-tarsi is a safe procedure with satisfactory mid- to long-term radiographic and clinical outcomes, independent of the severity of the fractures according to the Sanders classification.

FM102

Analysis of Failure in Total Ankle Arthroplasty *(8174)*

Dr. Roman Susdorf; Dr. Nicola Krähenbühl[1]; Dr. Roxa Ruiz; Prof. Dr. Alexej Barg[2]; Prof. Dr. Beat Hintermann

[1] Kantonsspital Baselland; [2] University of Utah, Salt Lake City, UT

Introduction: Given the increased case load of total ankle arthroplasty (TAA) in recent years, a better understanding of the reasons leading to implant revision is necessary to identify patients who are at risk for failure. The purpose of the present study was to retrospectively analyze reasons leading to implant failure in patients who underwent TAA for end-stage ankle osteoarthritis.

Methods: Out of the 1074 ankles who were retrospectively reviewed, 133 ankles (12.4%) underwent implant revision at a mean of 46 (range, 0.2 to 166) months. The reason for each revision surgery was classified

into six categories according to a previously published protocol: (I) aseptic loosening; (II) cyst formation; (III) instability; (IV) deep infection; (V) technical error; and (VI) pain without other cause. Two fellowship trained foot and ankle surgeons reviewed the charts of all patients who underwent implant revision, and assigned each patient to one of the six revision reasons.

Results: The most common revision reason was instability (n=48 [36.1%]), followed by aseptic loosening (n=36 [27.1%]), pain without other cause (n=16 [12%]), cyst formation (n=12 [9%]), deep infection (n=11 [8.3%]), and technical error (n=10 [7.5%]). Ankles with a major hindfoot deformity prior to index TAA were more likely to be revised than ankles with a minor deformity or plantigrade alignment. The 10-year estimated incidence probability for revision surgery including any of the metallic components was 12.5%.

Conclusion: The present study suggests that instability is a more common reason for implant revision following TAA than currently expected. Consequently, besides instability, all causes inducing either a varus or valgus deformity must meticulously be addressed during TAA to prevent implant failure.

FM103

Ankle Range of Motion after Total Ankle Arthroplasty *(8182)*

Dr. Roxa Ruiz; Dr. Roman Susdorf; Dr. Nicola Krähenbühl[1]; Prof. Dr. Beat Hintermann

[1] Kantonsspital Baselland

Introduction: Though total ankle arthroplasty (TAA) has become a well-accepted alternative to fusion for treatment of end-stage ankle osteoarthritis (OA), controversy still exists regarding the appropriate indication. Trauma as the primary cause of end-stage ankle OA accounts for up to 80% of all cases. As a consequent, the periarticular soft tissue is typically in poor condition, and allows only little motion. The purpose of this study was to assess the gained motion after TAA in end-stage ankle OA, and to evaluate whether there is a benefit for patients who underwent an additional heel cord lengthening (HCL).

Methods: 1074 primary TAA (1006 patients, mean age 62.5 [17-88] years) were performed between May 2003 and December 2017 using the Hintermann Series H3 prosthesis. After prosthesis insertion, the ankle was gradually mobilized into dorsiflexion. If a minimum of 10 degrees of dorsiflexion could not be obtained, an HCL was performed. Ankle range of motion (ROM) was determined with the use of a goniometer preoperatively (PreOP), one year postoperatively (PostOP), and at the last follow-up (LastFU; 5.1 [0.6-15.2] years). Pain was assessed using a Visual Analogue Scale (VAS). A 4-point Likert scale was used to quantify patient's satisfaction.

Results: Preoperative ankle ROM increased from mean 30.6° (0-69) to 33.4° (5-65) one year postoperatively, and decreased to 30.9 (0-70) degrees at the LastFU (each P <0.001). Ankle ROM improvement after TAA was higher in ankles with a low preoperative ROM (P <.0001). Ankle ROM before and one year after surgery was higher in patients with primary ankle OA compared to patients with posttraumatic (P=.007) or systemic (P=.013) etiologies. At the LastFU, ankle ROM was comparable between the etiologies (P=.850). A higher pain level (P <.0001) and a lower satisfaction score (P <.001) PostOP and at the LastFU were associated with decreased ankle ROM. In ankles undergoing HCL during TAA, ROM was reduced by 6.7° (P <.0001). HCL showed no effect on VAS for pain (P=.090) or patients' satisfaction (P=.275).

Conclusion: TAA seems to have little potential to increase ankle ROM. The higher pain level and decreased patients' satisfaction in case of a lower ankle ROM following TAA confirms the importance of preserving ankle motion in patients with end-stage ankle OA. The effect of HCL is disappointing and it underlines that heel cord contracture is not the only cause of limited motion in end-stage ankle OA

FM104

Predictive Associations Between Patient- and Lesion-Specific Characteristics with Postoperative Outcome After Autologous Matrix-Induced Chondrogenesis for Osteochondral Lesions of the Talus *(8344)*

Dr. Jakob Ackermann; Dr. Fabio A. Casari; Dr. Felix Waibel; PD Dr. Florian Imhoff; Dr. Stephan Wirth; Dr. Arnd Viehöfer

Balgrist Universitätsklinik

Purpose: Autologous matrix-induced chondrogenesis (AMIC) is a viable treatment option for osteochondral lesions of the talus (OLTs) with good clinical outcome and high return to sport. This study sought to determine potential predictive associations between patient-/lesion-specific factors, clinical outcome and need for reoperation in patients that underwent isolated AMIC for OLTs.

Methods: A total of 35 patients (21 male and 14 female) with a mean age of 34.7 15 years who underwent isolated cartilage repair with AMIC for OLTs were evaluated at a mean follow-up of 4.5 1.9 years. Clinical notes, operative reports and preoperative imaging were reviewed for each patient. Patients completed American Orthopaedic Foot and Ankle Society (AOFAS) scores at final follow-up, as well as Tegner scores at final follow-up and retrospectively for pre-injury and pre-surgery timepoints. Pearson correlation coefficients and linear regression models were used to distinguish associations between sex, age, body mass index (BMI), etiology, duration of symptoms, smoking status, blood pressure levels, defect size, the need for subsequent surgery due to arthrofibrosis/anterior impingement and patient-reported outcomes.

Results: At final follow-up, good clinical outcome was reported with AOFAS and Tegner averaging 92.6 8.3 and 5.1 1.8, respectively. Overall, 9 patients (25.7%) required subsequent surgery due to arthrofibrosis/anterior ankle impingement. Smoking was the only factor that showed significant correlation with the need for reoperation (r=0,344; p=0.043). Both, BMI and duration of symptoms were independent predictors for postoperative AOFAS and the delta from Tegner pre-injury to Tegner at final follow-up with positive smoking status showing a trend towards worse AOFAS scores, but this did not reach statistical significance (p=0.054).

Conclusion: Cartilage repair with AMIC for the treatment of OLTs shows satisfying clinical outcome and high return to sport. Especially patients with normal BMI and chronic symptoms benefit from this procedure. Conversely, smoking cessation should be considered before cartilage repair due to the increased rate of reoperation and possibly worse clinical outcome seen in patients with positive smoking history

FM105

Clinical and functional outcome of peroneal tendon longus to brevis transfer with minimum two year follow-up – preliminary results *(8345)*

Dr. Marco Burkhard; Dr. Octavian Andronic; Dr. Arnd Viehöfer; Dr. Stephan Wirth; PD Dr. Florian Imhoff; Dr. Stefan Fröhlich

Universitätsklinik Balgrist

Introduction: Peroneal tendon pathology can cause debilitating pain and surgical treatment remains controversial. Several studies recommend peroneal tenodesis or transfer when more than half of the brevis tendon is affected. However, the clinical and functional outcome of peroneal tendon transfer surgery has not been reported, yet.

Methods: We retrospectively reviewed patients, that underwent standardized peroneal longus to brevis surgery at our institution starting in 2013 with a minimum follow-up of two years. Patients with neurological deficits and previous or following middle- or hindfoot joint fusion surgery and any contralateral ankle surgery were excluded. Clinical outcome parameters included the AOFAS hindfoot score, Foot Function Index (FFI), and Karlsson-Peterson score. Functional outcome was measured with isokinetic strength tests using a Con-Trex Dynamometer following a standardized warm-up and preloading protocol: Con- and excentric eversion and inversion tests at 30°/s and 120°/s. Additionally, active range of motion (ROM) was compared to the non-operated contralateral foot.

Results: In total 31 patients underwent peroneus longus to brevis transfer, of which 18 (58%) had answered the questionnaires and 15 (48%)

were available for isokinetic measurements to date. Reported preliminary results: Clinical outcome scores (mean ±SD) were good with AOFAS 84 ±17, FFI-D pain 26% and FFI-D function 33%, and Karlsson-Peterson score 77 ±25. There was no significant difference in isokinetic strength in eversion and inversion of the operated ankle in comparison to the normal/non-operated contralateral foot all p>0.05). Isokinetic strength in eversion of the operated ankle was 16.3 Nm ±4.9 (108% of contralateral), 12.9 Nm ±4.6 (98%) and 18.8 ± 4.5 Nm (101%) at concentric 30°/s, concentric 120°/s and excentric 30°/s tests, respectively. Isokinetic strength in inversion was 15.7 ±5.2 Nm (102% of contralateral), 16.0 ±6.4 Nm (102%) and 18.7 ±3.3 Nm (103%) at concentric 30°/s, concentric 120°/s and excentric tests 30°/s, respectively. There was neither a difference in ROM in eversion nor inversion compared to the contralateral side (Eversion/Inversion 14.5-0-18.7 vs. 14.1-0-16.1).

Conclusion: Peroneus longus to brevis transfer is a valuable option for peroneal tendon tears involving more than half of the brevis tendon and leads to good clinical outcome without any compromise in strength and range of motion in comparison to the contralateral ankle joint.

FM106

CAOS: Where do we stand in the field of Foot and Ankle Surgery *(8353)*

Halah Kutaish; Dr Antoine Acker; Dr Richard Stern; PD Dr Mathieu Assal

Centre Assal de Médecine et de Chirurgie du Pied

Introduction: Computer-assisted orthopaedic surgery (CAOS) is a real-time navigation guidance that supports surgeons during orthopaedic cases. Its use helps to increase precision, allows for less invasive surgery and helps to achieve the surgical goals as planned. Intraoperative imaging certifies that the initial aim of the surgery has been achieved and if necessary adjusted immediately. Very little has been reported regarding its use in the challenging field of foot and ankle surgery where rich anatomy and a wide variety of procedures prevail. This study explores the possible applications of real time navigation and CAOS in the field of foot and ankle surgery.

Methods: Indications for use of CAOS and navigation were elaborated on a case-by-case bases by a team of two surgeons (foot and ankle, and trauma specialists) and a research fellow from 2012 to 2019. For each case, a preoperative discussion took place to assess whether the surgery would possibly benefit from the innovative technology. The study design was a prospective qualitative case study design. Groups of pathologies/traumas for which the technology brought a substantial benefit were established based on the added value/benefit. Parameters which were taken into account were: 1/ accuracy of the navigation as revealed by intraoperative CT, 2/ technical complexity of implementation 3/ additional time (more than 10% additional time was considered as not acceptable).

Results: During the study period we applied the technology on 750 patients. We identified 18 different surgical interventions which were found to substantially benefit from this novel technology according to the set criteria. A comprehensive protocol was developed for each of these procedures and published (Navigated Foot & Ankle Surgery, 2019).

Conclusion: This preliminary study supports use of CAOS in the field of foot and ankle surgery. Indications have largely extended to a variety of fields from trauma, delayed reconstruction, congenital abnormalities and even foreign body extraction. The field of foot and ankle surgery still holds numerous unexplored possibilities that need to be studied.

FM107

Matrix-induced Autologous Chondrocyte Implantation (MACI) Grafting for Osteochondral Lesions of the Talus: Clinical and Radiological Long-Term Follow-Up *(8410)*

Dr. Christopher Lenz[1]; Dr. Shu Tan[2]; Andrew L Carey[3]; Dr. Kaensong Ang; Dr. Timothy E Schneider[4]

[1] Kantonsspital Baden; [2] Victoria House Medical Imaging; [3] Baker Heart and Diabetes Institute; [4] Melbourne Orthopaedic Group

Introduction: Matrix Induced Autologous Chondrocyte Implantation (MACI) is an established treatment method for larger joints and has shown promising results in the ankle as well. We present a series of patients post MACI in the ankle with long-term follow-up and assess clinical and radiological outcome.

Methods: Follow-up of 15 patients who underwent MACI grafting from August 2003 to February 2006. Mean follow-up was 12.9 years. Clinical evaluations were conducted using the AOFAS, FAAM and VAS scoring systems and MOCART scoring system for radiological evaluation.

Results: The mean size of the talar osteochondral defects was 212 mm2. We found a significant improvement in mean AOFAS score from 60 (range, 25 to 87) to a mean postoperative score of 85 points (range, 69 to 100, P=.001). The FAAM score for ADL was 89% (range, 62 to 99). The mean MOCART score was 65 points (range, 30 to 100) and agreement between assessors was significant (P<.001). However, the MOCART scores did not correlate with FAAM scores (P=.86).

Conclusion: Considering long-term follow-up, we believe MACI is a reliable treatment method for talar osteochondral defects providing lasting pain relief and satisfying clinical results. However, considering the resource intensity, costs and requirement for a two-staged procedure that does not appear to be more effective than lesser intensive options, we refrain from recommending the MACI procedure as the primary treatment option for osteochondral lesions of the talar dome. The clinical utility of the MOCART score requires further scrutiny since we were not able to show any correlation between the score and clinical outcome.

FM108

Hallux saltans, a rare finding: diagnosis and arthroscopic treatment in a young ballet dancer. *(8435)*

Dr Ainù Verdini Gasti[1]; Dr Felix Neumayer[2]

[1] eHnv Hôpital Yverdon Les Bains; [2] eHNV, Saint Loup

Hallux saltans is an uncommon pathological entity encountered especially in correlation with activities as ballet dancing or football.

We report the case of a 16-year-old female, upcoming professional ballet dancer, presenting a 2-years history of pain and swelling of her right ankle, associated with triggering of the hallux and audible cracking at active extension.

After an MRI diagnosis of tenosynovitis of right FHL tendon, the patient is treated operatively by posterior endoscopy. We observed a thickening of the FHL tendon which was entrapped by the fibrous tissue of the tendon sheath. Posterior arthroscopic tenolysis was performed resulting in an immediate relief from triggering of the hallux.

During post-operative period the patient was able to start dancing again. She remained asymptomatic at the latest follow-up 8 months after surgery.

In conclusion, arthroscopic release of FHL tendon sheath has proven to be a useful and mini-invasive technique to approach hallux saltans pathology in a semi-professional young ballet dancer, permitting fast sport resumption.

FM109

Magnetic resonance imaging grading and pattern of peroneal brevis tendon abnormality and its correlation and predictive value with intraoperative findings *(8450)*

Dr. Marco Burkhard; Tobias Götschi; Dr. Christoph Germann; Dr. Stephan Wirth; PD Dr. Florian Imhoff; Dr. Benjamin Fritz

Balgrist Universitätsklinik

Introduction: Peroneus brevis tendon disorders are a frequently underdiagnosed source of lateral hindfoot pain and dysfunction. Clinical symptoms vary, whereas MRI is the gold standard diagnostic tool. However, reliable predictive radiological parameters are missing. The aim of this study was to evaluate the radiological assessment of peroneus brevis tendon disorders and compare observer-based patterns with intraoperative findings and subsequent surgical treatment.

Methods: Operative records of patients undergoing peroneal tendon surgery at our institution between 2013 and 2019 were retrospectively analyzed. Inclusion criteria were clinical symptoms of pain or swelling of the peroneus brevis tendon leading to a surgical intervention of tendon inspection and no further treatment due to normal findings (1), tubularizing suture due to a longitudinal split (2) and longus to brevis transfer due to severe tendinopathy (3). The preoperative MRI were reviewed by

three blinded, senior musculoskeletal radiologists and evaluated for categorial findings for peroneal brevis tendon: shape, tendinopathy, split, substance defect, contrast enhancement, tendon position, and tendon sheath fluid thickness. Statistical analysis using fisher's exact test, pearson chi square test, spearman rank correlations, interreader reliability (kappa (k)) and multivariate regression models for prediction of the surgical status was calculated.

Results: A total of 193 patients were included in the study with a reported surgical treatment (1) in 16%, (2) in 71%, and (3) in 17%. Interreader reliability was best for contrast enhancement (k= 0.895) and its subgroup analysis. Reliability was moderate for substance defect (k=0.479), tendon position (k=0.576), and slight to fair for shape (k=0.113), split (k=0.367), and tendinopathy (k=0.391). Most predictive parameters for surgical treatment were contrast enhancement of the synovium (r=0.376, p <0.001), tendon sheath (r=0.377, p <0.001), tendinopathy (r=0.364, p <0.001), and split (r=0.374, p <0.001). Lowest values were seen for tendon position (r= 0.025, p <0.001) and tendon sheath fluid thickness (r=0.260).

Conclusion: MRI-based evaluation of peroneus brevis tendon pathologies showed best reliability and most predictive values for contrast enhancement regarding subsequent surgical treatment. A classification scheme to maximize predictive outcome based on decision tree modelling for different MRI criteria will be created for future use.

FM110

Biomechanical t of peroneus brevis split tears and subsequent tubularization: a cadaver study *(8496)*

Dr. Tudor Trache[1]; Elias Bachmann[2]; Dr. Arnd Viehöfer[3]; Dr. Roland Camenzind[3]; Dr. Lukas Jud[3]; Dr. Stephan Wirth[3]; PD Dr. Florian Imhoff[3]

[1] Universitätsspital Balgrist; [2] Universitätsklinik Balgrist / Institute for Biomechanics, ETH Zurich; [3] Universitätsklinik Balgrist

Introduction: Peroneal tendon pathologies are common seen in patients with retromalleolar pain and chronic ankle instability. However, it is unclear if longitudinal tendon split tears lead to biomechanical disadvantages and whether surgical treatment, such as tubularizing suture or debridement up to 50% of the tendon diameter, restore or change these parameters, respectively. The purpose of the study was to evaluate the biomechanical effect of peronaeus brevis tendon split lesions and subsequent tubularizing suture in a cadaveric model.

Methods: Thirteen cadaveric lower extremity specimens were obtained and underwent MRI investigation, excluding previous peroneal tendon pathology and fibular groove and fifth metatarsal abnormalities. Specimens were dissected and fixed in an upright standing position (1), dorsi flexion (2) and plantar flexion (3). The proximal peronaeus longus tendon was statically loaded (35N), while the proximal peronaeus brevis tendon/muscle sheet was clamped to a servo electromechanical uniaxial testing machine. Four different conditions of the peronaeus brevis tendon were created: native, split tear, tubularizing suture, 50% tendon resection. Outcome measurements were reported as tendon length to preload and stiffness throughout different loading conditions and cyclic loading (35-100N and 35-200N).

Results: Preliminary results (no significances reported, yet) showed an increase of length to preload of 2.8mm after a tendon split tear. Tubularizing suture was able to restore preload condition. However, stiffness did not show comparable results to the native tendon after tubularization. A 50% reduction of the tendon diameter resulted in less preload compared to native. Within our preliminary observations there was no difference of preload and stiffness of the tendon conditions throughout different ankle joint positioning.

Conclusion: Tendon split tears lead to changed preloading conditions in a simplified biomechanical setup and may be restored with tubularizing tendon suture, whereas stiffness was not altered.

FM111

Syndesmotic Stabilisation with TightRope and Internal Brace – Technique and Clinical Outcome *(8534)*

Dr. Christopher Lenz[1]; David W Shepherd[2]

[1] Kantonsspital Baden; [2] Melbourne Orthopaedic Group

Introduction: Syndesmotic injuries are associated with long recovery times and high morbidity. Screw fixation and suture button devices provide varying stability to the syndesmosis. A loss of reduction and malreduction is reported with screw fixation. A single suture button device seems to confer sufficient stability. Systematic reviews of outcomes show similar outcomes with screw and suture button techniques, with less loss of reduction in suture button technique and a trend to better outcomes. Techniques have developed which directly reinforce the AITFL, and may allow early rehabilitation, and avoid removal of devices. This study aimed to assess the results of syndesmotic stabilisation with dynamic stabilisation of the syndesmosis and reinforcement of the AITFL, with an early mobilisation program.

Methods: This retrospective case series included 30 patients with a mean age of 31 years. Injuries were classified as acute or chronic (surgery more than three months after injury). Syndesmotic instability was confirmed with clinical examination, MRI and weightbearing CT. In all cases arthroscopic assessment confirmed the instability intraoperatively. Dynamic syndesmotic stabilisation with a single suture button (TightRope®; Arthrex Inc., Naples, Florida) was performed followed by the placement of an Internal Brace with Fibretape (Arthrex Inc., Naples, Florida) over the AITFL. A standardised postoperative rehabilitation protocol was established. Patients were asked to weight bear in a CAM boot for 6 weeks, commence sagittal Range of Motion (ROM) at 2 weeks, cycling at 4 weeks. At 6 weeks patients continued with fulll ROM and strenghtening, running and cutting at 8 weeks and return to sports at 10 weeks. FAAM scores were collected postoperatively.

Results: FAAM scores were collected at an average of 13 months after surgery. Overall, mean FAAM scores for Activities for Daily (ADL) were 94%, and for Sport 87%. The mean percentage of level of function (LoF) for ADL was 94%, and for Sport 90%. In chronic injuries the Sport subscale was worse (76%, LoF 83%).

Conclusion: This emerging technique aims to directly stabilise the AITFL and the Interosseous components of the syndesmosis, and allow early mobilisation and return to sport as early as 10 weeks. Early results show the procedure is safe, with comparable results to the literature. Long term follow up will address long term outcomes, requirement for removal of devices and how well the Internal brace is tolerated.

FM112

Hindfootnailing in failed surgery and fracture managment *(8560)*

Dr. Christophe Kurze; Prof. Dr. Fabian Götz Krause

Inselspital, Bern University Hospital

Introduction: Management of nonunion or fragility fractures of the ankle is challenging. Non-operative treatment often requires significant periods of reduced weight bearing. Operative fixation options, on the other hand, are often limited due to poor soft tissues and osteoporotic bone. In those cases, hindfootnailing is a well-established method gaining enough structural strength to allow quick weight bearing. The aim of this study was to review our experience with tibiotalocalcaneal nailing.

Methods: Restrospective, single-center case series with n= 36 patients who received a hindfootnail between 2012 and 2019. The mean age was 61,7 +- 11,4 years. Mean follow up was 19,4 +- 11,4 months. In n=26 patients Stryker T2 hindfootnail (length 150mm (n=3), 200mm (n=21), 300mm (n=2)) and in n=10 Synthes expert arthrodesis hindfootnail (length 150mm (n=2), 180mm (n=5), 240mm (n=3)) was used. Surgical indication included nonunion after previous surgery or trauma n=16, osteoarthritis n=6, fracture n=4, charcot arthropathy n=4, infection n=4, prosthetic failure n=1 and excessive hindfoot deformity n=1. 39% of the patients suffered from diabetes mellitus. TTC-fusion was performed in n=27 cases, tibiotalar fusion in n=4 cases, osteosynthesis without fusion n=4 cases. In one tumor case cementaugmented osteosynthesis was done.

Results: All patients except one were able to walk again. 25% of the population suffered from major complication. Major complication were defined as complication, which needed surgical revision. In n=2 patients superficial wound revision was performed. In n=4 cases multiple revision were necessary due to infection. One of those cases ended in below-knee amputation due to peripheral artery disease. Screws or bolts had to be revised in n=3 cases. 28% of the population died by 2019.

Conclusion: Hindfootnails are a good option for quickly regaining the ability to walk in trauma as well as in failed surgery patients. However, there is a high failure rate in our series, which is explained with the serious comorbidities. Those comorbidities are also responsible for the high deathrate. Nonetheless, hindfootnailing is a valuable method in cases of difficult soft tissues and frail, osteoporotic bone.

FM113-FM125: BASIC RESEARCH

FM113

Studying edema formation after release of the infraspinatus muscle as experimental model of rotator cuff lesions in sheep *(8263)*

PD Dr Alexandre Lädermann[1]; Rieke Gehrke; Karina Klein; Salim Darwiche; Peter Schwarzenberg; Thomas Steffen; Karl Wieser; Brigitte von Rechenberg

[1] Hôpital de La Tour

Aim: The animal experiments were designed to prove muscle edema formation after release of the infraspinatus tendon as model of acute rotator cuff tears.

Background: In clinical cases of acute rotator cuff lesions edema can be visualized in MRIs. The extend, effect and importance for muscle degeneration is unkown and not considered in the current literature.

Methods: An established animal model in 14 sheep with acute release of the infraspinatus tendon (osteotomy of the greater tuberosity) was used. An osteotomy of the major tubercle was performed including the insertion of the infraspinatus tendon. To allow retraction of the muscle and avoid fibrotic adhesion over time the bone chip was covered with a plastic drain. The study was divided in a preliminary (2 sheep) and main study (12 sheep). In both, two groups were made. In one group only surgical muscle release and subsequent retraction occurred. In the other group standardized additional trauma to the myotendinous unit was added by stretching the muscle to its maximum length before a blow to the unit was applied with a specially designed apparatus. In the preliminary study MRIs were performed and biopsies were taken at time point, 0, 1,2, 3 and 4 weeks to determine the time point for peak edema formation. In the main study MRIs were performed at time 0, 2 and 4 weeks and excision biopsies were taken at 0, 3 and 4 weeks. In CTs density measurements of the muscle were made using a customized algorithm. Two thirds of the biopsies were evaluated histologically, one third was used for lyophilization and proof of water content (wet weight-lyophilized probe = water content). Histological evaluation included qualitative and quantitative assessment of muscle fibers, interstitial tissue and fat content.

Results: Edema formation was proven in all sheep and pronounced in the additional trauma group. Edema formation in MRI started at week 2, reached its plateau at 3 continuing into the fourth. Lyophilization showed highest water content at 3 weeks. Histology confirmed findings with interstitial spaces between muscle fibers being largest at 3 weeks. At 4 weeks ingrowth of mesenchymal cells into the interstitial spaces could be observed. Fat content was not increased in muscle biopsies. Deterioration of muscle fibers and size started at 2 and was highest at 4 weeks.

Conclusions: Muscle edema is an important factor in cuff lesions and should be investigated as therapy target in the future.

FM114

Evaluation of the activity of several isolated lytic bacteriophages on a collection of Staphylococcus aureus and Staphylococcus epidermidis clinical isolates collected from patients with prosthetic joint infections. *(8145)*

Dr Diane Wernly[1]; Gregory Resch[2]; Prof. Dr Olivier Borens[1]

[1] CHUV Cente Hospitalier Universitaire Vaudois; [2] CHUV & Université de Lausanne

Introduction: As the number of total joint arthroplasties (TJA) rises constantly so do prosthetic joint infections (PJI). The management of PJI is now well standardized: depending on the duration of the symptoms, surgery is mandatory and always combined with antibiotics. An important factor for treatment failure in PJI is antibiotic resistance, which is a major challenge and stimulates the current development of complementary antimicrobial strategies, such as bacteriophages, which can outsmart microbial strategies such as biofilm formation. The goal of this project was to evaluate the susceptibility of a S. aureus and S. epidermidis collection of clinical isolates collected from patients with PJI to a collection of S. aureus and S. epidermidis lytic phages.

Methods: Representative strains of S. aureus et S. epidermidis were collected from patients with PJI at CHUV. They were all grown aerobically at 37°C for 16h either on Tryptic Soy Agar (TSA) plates or in liquid with shaking in Tryptic Soy Broth (TSB). Bacteriophages were either collected directly from wastewater samples or provided by collaborators. A total of 21 bacteriophages were tested in this study. This collection consisted of 15 S. aureus, four Staphylococcus xylosus and two S. epidermidis phages. Phagograms performed through diluted drop tests were used to test the susceptibility of each bacterial strain to each available phage. Efficiency of Plating (EOP), defined as the ratio of Plaque Forming Units (PFU)/mL obtained on a reference strain to the PFU/mL on a given strain, was calculated for each strain.

Results: S. aureus phages showed broad host range infecting 3.5% to 65% of S. aureus strains. Only seven S. aureus strains were resistant to all phages tested. 11 strains were only susceptible to one phage. One S. epidermidis phage infected 45% of S. epidermis strains.

Conclusion: This preliminary study allowed us to confirm that the S. aureus/S. epidermidis phage collection gathered from our local laboratory provides a very high coverage on a representative collection of S. aureus strains from patients suffering from PJI, thus offering the perspective to develop personalized phage cocktails therapy for our patients. Despite good coverage of one phage, increasing the number of specific phages available in our collection is needed to reach the same status for S. epidermidis.

FM115

A novel function of Noggin as a regulator of bone remodelling *(8329)*

Dr. Eliza Hartmann[1]; Fatemeh Safari[2]; Mark Siegrist[2]; Silvia Dolder[2]; Prof. Dr. Willy Hofstetter[2]; PD Dr. Frank Michael Klenke[1]

[1] Inselspital, Universitätsspital Bern; [2] Universität Bern, Departement für Biomedizinische Forschung

Introduction: Bone Morphogenetic Protein 2 (BMP2) is used in orthopaedic surgery to promote bone healing. The endogenous synthesis of BMP-2 antagonist family members, however, may limit the efficacy of exogenous BMP2. Noggin is one of these inhibitors that blocks the effects of BMP on the differentiation and activation of osteoblast (OB) in vitro and in vivo and inhibits OB-mediated osteoclast (OC) development. Furthermore, Noggin was found to modulate osteoclastogenesis through a direct effect on OC lineage cells. The present study aimed at elucidating the underlying mechanisms of these effects.

Methods: Direct (conventional culture dishes) and indirect (transwell culture dishes) co-cultures of murine OB/OPC (Osteoclast Progenitor Cells) and cultures of OPC alone were supplemented with combinations of Noggin, BMP2, L51P (engineered, inactive variant of BMP2) and DMH1 (BMP receptor 1 inhibitor).

Results: In cultures of OPC, Noggin but not DMH1 caused an increase in the number of OC by a factor of 3 ($p < 0.01$). This effect could not be reversed by BMP2 and L51P, respectively. In contrast, in co-cultures of OB/OPC, exposure to Noggin attenuated OC development. In direct co-

cultures, this inhibitory effect of Noggin was blocked by BMP2 and L51P. In both direct and indirect co-culture systems, exposure to Noggin induced the release of GM-CSF, a potent inhibitor of osteoclastogenesis, by a factor of 6 and 4, respectively ($p < 0.01$). Treatment of the cultures with αGM-CSF antibody, however, restored OC development in the indirect co-culture system only.

Conclusion: The data reveal a previously unknown function of Noggin directly acting pro-differentiation on OC lineage cells independently of BMP signalling. In co-cultures, Noggin induced OB-derived GM-CSF expression mediates an inhibitory effect on OC development. Furthermore, cell-cell contact between OB and OPC is required for mediation of the maximal inhibitory effects of Noggin on OC development. These novel effects of Noggin on bone remodelling may help to overcome the current limitations associated with the therapeutic use of bone morphogenetic proteins. The nature of potential interaction partners for Noggin, however, remains to be elucidated.

FM116

Is The Risk Of Secondary Peri-Implant Fracture After Trochanteric Fracture Consolidation Similar When Using Short Or Long TFNA? *(8360)*

Dr. Adam Breceda; Ivan Zderic; Dr. Clemens Schopper; Dr. Jana Schader; Dr. Dominic Gehweiler; Prof. Dr. Geoff Richards; Prof. Dr. Boyko Gueorguiev; Dr. Andrew Sands

Introduction: It is common belief that consolidated intramedullary nailed trochanteric femur fractures can result in secondary midshaft or supracondylar fractures, involving the distal screws, when short or long nails are used, respectively. In addition, no sufficient data exists in the literature to indicate when short or long nails should be selected for treatment. The aim of this biomechanically study is to investigate in direct comparison short versus long Trochanteric Femoral Nail Advanced (TFNA) fixation in a human cadaveric model in terms of construct stability and generation of secondary fracture pattern following trochanteric fracture consolidation.

Methods: Eight intact human cadaveric femur pairs were assigned to 2 groups of 8 specimens each for nailing using short or long TFNA with blade as head element. Each specimen was first biomechanically preloaded at 1Hz over 2000 cycles in superimposed synchronous axial compression to 1800N and internal rotation to 11.5Nm. Following, internal rotation to failure was applied over an arc of 90° within 1 sec under 700N axial load. Torsional stiffness, torque at failure, angle at failure and energy at failure were evaluated. Fracture patterns were analyzed.

Results: Outcomes in the study groups with short and long nails were 9.7±2.4Nm/° and 10.2±2.9Nm/° for torsional stiffness, 119.8±37.2Nm and 128.5±46.7Nm for torque at failure, 13.5±3.5° and 13.4±2.6° for angle at failure, and 887.5±416.9Nm° and 928.3±461.0Nm° for energy at failure, respectively, with no significant differences between them, $P \geq 0.167$. Fractures through the distal locking screw occurred in 5 and 6 femora instrumented with short and long nails, respectively. Fractures through the lateral entry site of the head element were detected in 3 specimens within each group. For short nails, fractures through the distal shaft region, not interfacing with the implant, were detected in 3 specimens.

Conclusion: From biomechanical perspective, the risk of secondary peri-implant fracture after intramedullary nailed trochanteric fracture consolidation is similar when using short or long TFNA. Moreover, for both nail versions the fracture pattern does not unexceptionally involve the distal locking screw.

FM117

Is a crosslink beneficial for single level traditional or cortical bone trajectory pedicle screw instrumentation? *(8453)*

Frédéric Cornaz[1]; Jonas Widmer[1]; Marie-Rosa Fasser[1]; Prof. Jess Snedeker[1]; Dr. Keitaro Matsukawa[2]; Dr. José Miguel Spirig[3]; Prof. Dr. Mazda Farshad[3]

[1] Universitätsklinik Balgrist / Institute for Biomechanics, ETH Zurich; [2] Department of Orthopaedic Surgery, National Hospital Organization, Murayama Medical Center, Musashimurayama; [3] Universitätsklinik Balgrist

Introduction: Stability is of paramount importance in spinal instrumentation. In 2009, the cortical bone trajectory (CBT), has been introduced with the aim of better screw hold, but this trajectory might provide less rigidity in lateral bending (LB) and axial rotation (AR) compared to the traditional trajectory (TT). The addition of a horizontal crosslink (CL) could be beneficial in counteracting this possible inferiority. The aim of this study was to compare the primary rigidity of TT with CBT screw-rod constructs and to quantify the effect of CL-augmentation in both.

Methods: Spines of four human cadavers (T9 – L5) were cropped into 15 functional spine units (FSU). Eight FSUs were instrumented with TT and seven FSUs with CBT pedicle screws. The segments were tested in six loading directions in three configurations: uninstrumented, instrumented with and without CL. The motion between the cranial and caudal vertebra was recorded.

Results: The range of motion between the CBT and the TT group did not differ significantly in either configuration. CL-augmentation did significantly reduce the ROM in AR (16.3%, 0.27°, $p < 0.025$) and flexion-extension (2.3%, 0.04°, $p < 0.025$) for the TT group and in AR (20.6%, 0.31°, $p < 0.01$) for the CBT-group.

Conclusions: The primary rigidity of TT and CBT single level screw-rod constructs does not show significant difference. The minimal reduction of ROM due to crosslinks-augmentation seems clinically not relevant with values of about 0.3°.

FM118

Contribution of passive structures during rotational and translational loads on the lumbar spine *(8455)*

Jonas Widmer[1]; Frédéric Cornaz[1]; Dr. Anne Gita Scheibler[1]; Samuel Nyffenegger[1]; Dr. José Miguel Spirig[2]; Prof. Jess Snedeker[1]; Prof. Dr. Mazda Farshad[2]

[1] Universitätsklinik Balgrist / Institute for Biomechanics, ETH Zurich; [2] Universitätsklinik Balgrist

Introduction: The contribution of anatomical structures to the stability of the spine is of great interest for diagnostic, prognostic and therapeutic evaluation of pathologies of the spine. Although a plethora of literature is available, the contribution of anatomical structures is still not well understood.

Methods: 50 functional lumbar spinal segments originating from 22 human lumbar cadavers were biomechanically tested in a displacement-controlled stepwise reduction study: The intertransversal ligaments (ITL), the supraspinous and interspinous ligaments (ISL&SSL), the facet joint capsules (FJC), the facet joints (FJ), the ligamentum flavum (LF), the posterior longitudinal ligament (PLL) and the anterior longitudinal ligament (ALL) were subsequently reduced. In the intact state and after each transection step, the segments were physiologically loaded in flexion (F), extension (E), axial rotation (AR), lateral bending (LB) and with anterior (AS), posterior (PS) and lateral shear (LS). 29 specimens with only minor degeneration, representing a healthy subpopulation, were selected for the here presented evaluation. Quantitative values for load and spinal level dependent contribution patterns for the transected structures were derived.

Results: The intervertebral disc is exposed to about 70% of the applied load in LB and during shear loading, but is mostly unaffected by load in F, E and AR (less than 35%). The FJ&FJC are the main stabilizer in AR with 51%, but provide only 10% of the stability in E. The LF and the PLL contribute mainly in F (22% and 16% respectively), while the ALL plays a major role during E (41%) and also contributes during LB (15%). The contribution of the ITL and the ISL&SSL are very small in all loading directions (below 2% and below 6% respectively).

Conclusion: The present work is the first to quantify the contribution of the passive spinal structures in a load-controlled manner during physiological loading. The observations reveal, among others, high exposure of the intervertebral disc during LB and shear loading and high contribution of the FJ&FJC in AR. While the ALL, PLL and LF provide intuitive contribution, only minor relevance of the ITL is measured. Similarly, the contribution of ISL&SSL during physiological loading is small and can be explained by the large slack length of these ligaments.

FM119

NADPH oxidase 4 deficiency attenuates experimental osteoarthritis in mice *(8456)*

Dr Karim-Stéphane Oudina; Joris Paccaud; Dr Thomas Laumonier; Prof. Dr Didier Hannouche

University Hospital and Faculty of Medicine

Introduction: Osteoarthritis (OA) is a degenerative disease characterized by damage of articular cartilage, alteration of subchondral bone, and inflamed synovium. The articular cartilage is essentially composed of an avascular matrix produced by chondrocytes. In OA, articular cartilage follows a progressive degeneration, where low-grade inflammation could play a pivotal role through an oxidative stress-dependent mechanism and exposure to reactive oxygen species (ROS). The objective of this study was to evaluate the role of NADPH isoform 4 (Nox4) during human chondrogenesis in vitro and during experimental OA in mice.

Methods: In vitro, human mesenchymal stem cell (MSC) were pelleted and cultured in chondrogenic medium for 21 days. To mimic inflammatory conditions, IL-1 was added in culture medium for 4 days. qRT-PCR were performed and expression of target genes was normalized to GAPDH. In vivo, OA was induced by destabilization of the medial meniscus (DMM) in Nox4 knockout mice (Nox4-/-, n=10) and in wild-type littermate (WT, n=10). At day 0, mice were radiographed using a microCT and operated. Eight weeks after surgery, mice were radiographed and sacrificed for histology analysis.

Results: In vitro, we demonstrated by qRT-PCR that Nox4 is the only isoform expressed in human MSC and is significantly upregulated during human chondrogenesis in vitro. Upon IL-1 treatment, we observed a significant increase of Nox4 and MMP-1 gene expression, as compared to control conditions. In vivo, histological analysis of the knee joint, 60 days post-surgery, demonstrated that DMM induced significant OA damages in DMM-WT mice. Large areas of cartilage destruction were observed with matrix loss and surface denudation compared with the 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. By micro-CT, we observed no differences at day 0 between WT and Nox4-/- mice. However, 60 days after DMM, a significant 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: To our knowledge, these data demonstrated for the first time that Nox4 is the only isoform expressed by human chondrocytes generated in vitro. Moreover, we observed in vivo a significant decrease in the severity of OA in Nox4-/- mice. Taken together these results underline a major role of Nox4 in experimental OA in mice.

FM120

The stabilizing effect of spondylophytes in the lumbar spine *(8457)*

Frédéric Cornaz[1]; Jonas Widmer[1]; Dr. Anne Gita Scheibler[1]; PD Dr. Nadja Farshad-Amacker[2]; Dr. José Miguel Spirig[2]; Prof. Jess Snedeker[1]; Prof. Dr. Mazda Farshad[2]

[1] Universitätsklinik Balgrist / Institute for Biomechanics, ETH Zurich; [2] Universitätsklinik Balgrist

Introduction: Vertebral body osteophytes, namely "spondylophytes" are often observed during the process of spinal degeneration. However, it is largely unknown whether the mechanism of spondylophyte formation arises from compressive overloading resulting in the generation of load shielding bony spurs or ossification lesions at the annular ring due to extensive tensile stresses. Further, the biomechanical effect of spondylophytes on stability of spinal motion segments is unknown.

Methods: During a displacement-controlled stepwise reduction study on human lumbar cadavers, a subgroup of 25 spinal segments with spondylophytes were selected for this evaluation. Based on CT scans, the spondylophytes were categorized according to their anatomical position and severity. The load reduction after dissection of the spondylophytes was used to calculate their contribution to the passive stability of the segments in flexion, extension, axial rotation, lateral bending, anterior, posterior and lateral shear.

Results: Small ventral spondylophytes contribute to about 30% of the stability in extension, while only minimal contribution in the other loading directions including flexion is observed. Similarly, small lateral spondylophytes contribute to about 30% of the stability during contralateral bending, while contribution in bending towards the spondylophyte is comparably small with less than 13%. The contribution of spondylophytes is depending on their size and a progressive contribution in other loading directions is observed with increasing size reaching values of about 80%.

Conclusion: The present work is the first to quantify the biomechanical contribution of spondylophytes on the passive stability of the lumbar spine. Relevant position and size depending contribution to the passive stability is observed. Small spondylophytes manly act as a tensile structure, while only the more severe spondylophytes show additional contribution as a propping structure. These findings imply that the trigger for vertebral osteophytosis is rather excessive tensile stress than compressive overloading.

FM121

Mechanical responses to footwear interventions for knee osteoarthritis is patient-specific *(8459)*

Dr Guillaume Jaques[1]; Dr Julien Favre[2]; Prof. Dr Brigitte Jolles-Haeberli[3]

[1] CHUV & Université de Lausanne; [2] Swiss BioMotion Lab; [3] Département de l'Appareil Locomoteur

Objectives: Using footwear to modify the walking patterns of patients with knee osteoarthritis is very appealing, as knee mechanics has been related to disease progression. However, so far, the clinical effects of footwear interventions have been contrasted, with large variations among patients. A possible explanation for the inconsistent results could be that prior works focused on changing one gait variable (the peak value of the knee adduction moment (pKAM)), whereas other variables have also been associated with the disease (the impulse of the knee adduction moment (iKAM), the peak value of the knee flexion moment (pKFM) and the knee flexion angle at the heel strike (hKFA). There is a lack of data on the relationship between changes in pKAM and changes in the other variables. Therefore, it is possible that while an intervention improves the pKAM it worsens the other variables. This study tested the hypothesis of positive associations between changes in pKAM and changes in the other variables.

Methods: The gait of 10 patients, with low to moderate osteoarthritis, was analyzed using a standard procedure for four types of insoles. Regression models were used to characterize the associations between the changes in pKAM and the changes in the other variables, individually for each patient. Significance level was set at 5%.

Results: In all patients, the changes in pKAM were positively associated with the changes in iKAM ($0.4 < R < 1.0$). The changes in pKAM and pKFM were positively associated in two patients ($0.3 < R < 0.4$), and negatively associated in three patients ($-0.4 < R < -0.8$). Two patients reported a positive association between the changes in pKAM and hKFA ($0.5 < R < 0.7$).

Conclusion: This study showed consistent associations between the changes in pKAM and iKAM, but not between the changes in pKAM and the changes in the other variables. These results bring new insight that could explain the limited clinical improvements previously observed with interventions reducing the pKAM, and suggest that, in the future, footwear interventions for knee osteoarthritis should not only be cha

FM122

A New Concept For Screw-In-Screw Fixation Of Fragility Sacrum Fractures – Biomechanical Comparison Versus Transsacral And SI Screw Fixations *(8476)*

Ivan Zderic; Dr. Clemens Schopper; Dr. Moritz Lodde; Dr. Daniel Wagner; Prof. Dr. Geoff Richards; Prof. Dr. Boyko Gueorguiev; Prof. Dr. Pol Rommens; PD Dr. Yves Acklin

Introduction: Surgical treatment of fragility sacrum fractures with percutaneous sacroiliac (SI) screw fixation is associated with high failure rates of screw loosening, cut-through and turn-out. The latter is a common cause for complications, being detected in up to 14% of the patients. The aim of this study was to develop a new screw-in-screw concept and prototype implant for fragility sacrum fracture fixation and test it biomechanically versus transsacral and SI screw fixations.

Methods: Twenty-seven artificial pelves were assigned to three groups (n=9) for instrumentation of their right sites with either a transsacral screw, a SI screw, or the new screw-in-screw implant. Prior to implantation, a vertical osteotomy was set in zone 1 after Denis, while the symphysis was discontinued, resulting in a simulated unilateral pelvic ring pattern. All specimens were tested in upright position with the right ilium constrained. Validated setup and test protocol were used for complex axial and torsional loading to failure, applied through the S1 vertebral body to promote turning-out of the implants. Interfragmentary movements were captured via optical motion tracking. Screw motions in the bone were evaluated by means of triggered anteroposterior X-rays.

Results: Interfragmentary movements and implant motions in terms of pull-out, cut-through, tilt, and turn-out were significantly higher for SI screw fixation compared to both transsacral screw and screw-in-screw fixations. In addition, transacral screw and screw-in-screw fixations revealed similar construct stability. Moreover, screw-in-screw fixation successfully prevented turning-out of the implant, that remained during testing at 0° rotation around the nominal screw axis for all specimens.

Conclusion: From biomechanical perspective, fragility sacrum fracture fixation with the new screw-in-screw implant prototype provides higher stability than a SI screw, being able to successfully prevent turn-out. Moreover, it combines the higher stability of transsacral screw fixation with the less risky operational procedure of SI screw fixation and can be considered as their alternative treatment option.

FM123

New single stage, arthroscopic cartilage regeneration therapy with nasal chondrocytes *(8552)*

Dr. Gyözö Lehoczky[1]; Raluca Elena Trofin[2]; Karoliina Pelttari-Goeritz[2]; PD Dr. Marcus Mumme[3]; Prof. Dr. Martin Haug[4]; PD Dr. Christian Egloff[4]; Prof. Dr. Marcel Jakob[5]; Prof. Dr. Andrea Barbero[2]; Prof. Dr. Ivan Martin[2]

[1] Universitätsspital Basel; [2] Universität Basel; [3] Universitäts-Kinderspital beider Basel (UKBB); [4] Universitätsspital Basel (USB); [5] Crossklinik

Introduction: Current therapeutic approaches for hyaline cartilage repair require often two operations and expensive laboratory costs for engineering tissue grafts, however still not providing predictable, reproducible and durable restoration. Development of a reliable arthroscopic regeneration therapy is one main state-of-the-art interest on this field. Nasal chondrocytes (NC) have a higher and more reproducible chondrogenetic capacity than articular chondrocytes and were previously introduced in a first-in-human study to proof safety and feasibility. Cell isolation according to a new, short protocol would allow us for same-day, single-stage use of the cells. For their use without cell expansion, a gel with proliferative and chondroinductive promoting activity is needed. Pooled PRP extract – platelet lysate (PL) – is known for such properties, thus could "tune" the known chondrosupportive polyethylene glycol (PEG) gel.

Methods: Fresh nasal septal cartilage grafts were digested according to a new, rapid protocol ("rapid isolated" p0 NCs), cell yield, viability and proliferation rate were assessed. The p0 NCs were either used for in vitro pellet culture, or seeded in PL-PEG gels in a low cell number mimicking intraoperative yield (300.000 cells/1mL gel) and cultured in vitro for 4 weeks. For in vivo tests, an ectopic human osteochondral model was used to create a full thickness cartilage lesion of 4 mm diameter, filled with low-density rapid isolated p0 NCs in PL-PEG gel, and implanted subcutaneously in nude mice for 8 weeks.

Results: Rapid isolated NCs show similar viability (mean 98.28% vs 98.80%) and proliferative capacity (mean 0.70 vs 0.80 doublings/day) as cells after standard digestion; however, cell yield is even higher after the new protocol (mean 5.51x106 vs 2.47x106 cells/g tissue). Pellet culture showed good chondrogenetic capacity. In vitro gel cultures showed proliferation of the cells with 6.2 mean doublings in 4 weeks. At the meantime, also cartilaginous matrix production was observed, with GAG/DNA ratio of mean 12.65 (SD 2.87). In vivo experiments showed integration of the repair tissue in situ.

Conclusion: Rapid isolation protocol resulted in viable nasal chondrocytes with good in vitro chondrogenic capacity. The cells, implanted in low-density in PEG gel enriched with platelet lysate (PL-PEG gel) showed proliferation and chondrogenesis in vitro. This approach can lead to establish a new arthroscopic therapy for cartilage lesions.

FM124

Intra-individual comparison of human nasal chondrocytes and debrided knee chondrocytes: relevance for tissue engineering-based cartilage repair *(8559)*

Dr. Gyözö Lehoczky[1]; Francine Wolf[2]; PD Dr. Marcus Mumme[3]; PD Dr. Sebastian Gehmert[4]; Sylvie Miot; Prof. Dr. Martin haug[1]; Prof. Dr. Marcel Jakob[5]; Prof. Dr. Ivan Martin[2]; Prof. Dr. Andrea Barbero[2]

[1] Universitätsspital Basel; [2] Universität Basel; [3] Universitäts-Kinderspital beider Basel (UKBB); [4] UKBB; [5] Crossklinik

Objective: Implantation of autologous chondrocytes for cartilage repair requires harvesting of undamaged cartilage, which might be detrimental to the surrounding healthy cartilage. Previous studies from our laboratory demonstrated that chondrocytes isolated from nasal cartilage (NC) can produce high quality chondrogenic grafts capable of inducing articular cartilage repair. We investigated whether debrided Knee Chondrocytes (dKC) can exhibit comparable biosynthetic properties.

Methods: NC and dKC from 13 matched patients participating in one of two clinical studies (NCT01605201 and NCT026739059) were expanded in monolayer and then chondro-differentiated in 3D collagenous scaffold in medium with or without Transforming Growth Factor beta 1 (TGF-β1). Cell proliferation and amounts of cartilage matrix productions were assayed.

Results: dKC exhibited an inferior proliferation rate as compared to NC, and a lower capacity to chondro-differentiation. Resulting dKC-grafts contained low amounts of the cartilage specific matrix components glycosaminoglycans and type II collagen. Cartilage forming capacity of the dKC did not correlate with specific clinical parameters and was only partially improved by supplementing culture medium with TGF-β1.

Conclusions: dKC exhibit a reproducibly poor capacity to form cartilage grafts. Our in vitro data suggest that these cells might not be suitable for the generation of autologous grafts to be used for cartilage repair.

FM125

The effect of dexamethasone on orthopaedic device related infection in a rat model *(8567)*

Aron Keshishian[1]; Marc-Antoine Burch[2]; PD Dr. Stephan Zeiter[2]; Charlotte Wittmann[3]; Prof. Dr. Geoff Richards[3]; Dr Fintan Moriarty[3]; Dr. Henk Eijer[4]

[1] Spital Sonnenhof; [2] AO Research Institute; [3] AO Research Institute Davos; [4] Regional Spital Emmental

Introduction: Dexamethasone has been described to prevent postoperative nausea and vomiting (PONV) and reduce pain after total joint arthroplasty, leading to a reduction in hospitalization time and healthcare costs. However, dexamethasone may also lead to immunosuppression and has been associated with a higher rate of surgical site infections (SSI) if used over a longer period. There is a lack of studies investigating whether dexamethasone has any impact on the risk of developing, or the response to treatment of orthopaedic device related infection (ODRI). The aim of this experimental in vivo study in rats was, therefore, to determine if 1) dexamethasone increases the risk of developing a perioperative ODRI, and 2) whether dexamethasone compromises the efficacy of antibiotic therapy in established ODRI.

Methods: A Polyetheretherketone (PEEK) screw, pre-colonised with a clinical isolate of Staphylococcus epidermidis, was inserted in the cancellous part of the proximal tibia of 44 Wistar rats. To determine the effect of dexamethasone exposure on the risk of ODRI, the first group (n=10) received a single perioperative dose of dexamethasone adjusted to approximate clinical practice for prevention of PONV, and the second group received saline (n=10). The screws were colonised with a low dose of bacteria, no antibiotic therapy was given, and animals were euthanised after 9 days. To determine the effect of dexamethasone on the efficacy of antibiotic therapy, 24 rats received bacteria-colonised screws at a high inoculum and infection allowed to take hold for 7 days. Then, all rats received antibiotic therapy (cefazolin 30mg/kg 2x/d) from day 7 to day 21. The test group (n=12) received dexamethasone (low dose equivalent to long term therapy), and the control received saline (n=12) for 28 days. Changes of the bone morphology were measured by using longitudinal in vivo microCT scanning at regular intervals in all animals (D0, D9, D20, D28), as well as post-mortem quantitative bacteriology of implant, bone and soft tissue.

Results: In the risk study, there was no significance in the infection rate between the animals that were treated with a dexamethasone and the control animals (3/10 versus 2/8 respectively, P=0.38). There was also no significant difference in bone-implant contact and peri-implant bone volume in the CT scans. In the study investigating the impact on antibiotic treatment, there was again no difference in infection clearance between test and control groups (4/9 animals versus 6/9 animals respectively, P=0.27) and there was no significant difference in the CT data.

Discussion: Although extrapolation to the human patient is a challenge, this experimental data suggests that preoperative dexamethasone administration, as may be given for PONV or as an anti-inflammatory drug, does not increase the risk of ODRI. Similarly, low dose chronic dexamethasone does not impair antibiotic efficacy.

FM126

Follow up or foul up! A study of attrition in over 15'000 patients in a local spine surgeryregistry. (8541)

PD Dr. Anne Mannion, Dave O'Riordan, Dr. Tamas F Fekete, PD Dr. François Porchet, Dr. Frank Kleinstück, PD Dr. Dezsö Jeszenszky, PD Dr. Markus Loibl, Dr. Raluca Reitmeir, PD Dr. Daniel Haschtmann

Schulthess Klinik

Introduction: Patient-rated outcome measures are integral to the assessment of treatment success and an essential part of the documentation in surgical registries. Lack of compliance with follow-up (attrition) can threaten the validity of the outcomes reported in registry studies. Prior research indicates that demographic, socioeconomic, and medical factors may all contribute to attrition. These same characteristics are often also predictors of outcome. We studied the extent, nature and impact of drop-out in a long-established, in-house spine registry.

Methods: Data were analysed from 15'264 consecutive patients (60±17y; 46% men) who had undergone spine surgery in our Spine Center 1.1.06-31.12.17. Data were documented prospectively using EUROSPINE's Spine Tango Registry forms. Surgeons had completed a Surgery Form (clinical history, surgical measures, complications) for 99.1% cases. Patients had completed a Core Outcome Measures Index preop (90%) and at 3 mo (89%) and 12 mo (86%) follow-up (FU). Patients rated Global Treatment Outcome (GTO) at FU. We determined: (1) baseline characteristics of 12-mo responders vs non-responders, (2) 12-mo outcome in responders vs delayed responders (those responding only after further reminders; typically lost to follow-up in standard registry protocols), and (3) 3-mo outcome of 12-mo responders vs non-responders. Analyses included Chi-square, ANOVA and multivariable regression. Results The most notable independent predictors (each $p < 0.001$) of being a 12-mo non-responder were: lower age, non-Swiss, having semi-/private insurance, higher ASA, worse baseline COMI, and previous surgery. 19% patients received a reminder and half of them finally returned a questionnaire. The outcome of these delayed responders was worse than that of responders (74% vs 78% good GTO, respectively; p=0.008). The 3-mo outcome was worse for the 12-mo non-responders than for the responders (respectively, 66% vs 80% good GTO; $p < 0.0001$). All COMI results reflected those of GTO.

Conclusion: Although non-responders were relatively few in the present cohort (14%), they displayed distinctive characteristics and their outcome was significantly worse than that of responders. Without the resources to contact non-responders, outcome in registries will likely be overestimated, and falsely optimistic results reported. Knowing the risk profiles of non-responders may help to focus efforts to reduce attrition and improve the validity of registry data.

FM127-FM130: CHILDREN

FM127

Mid- and long-term Outcome of Salter's, Pemberton's and Dega's Osteotomy for Treatment of Developmental Dysplasia of the Hip – A Systematic Review and Meta-analysis *(8125)*

Dr Sophie Merckaert; Prof. Dr Pierre-Yves Zambelli; Dr Shannon Nicole Edd; Dr Daniele Starnoni[1]; Prof. Dr Brigitte Jolles-Haeberli

[1] Centre hospitalier universitaire de Lausanne / CHUV

Introduction: Innominate pelvic osteotomy of Salter (SIO), Pemberton's pericapsular osteotomy (PPO) and Dega's acetabuloplasty (DA) are the most performed procedures for treatment of developmental hip dysplasia. We performed a systematic review and meta-analysis of the past century in order to assess the mid- and long-term outcome of these techniques.

Materials and Methods: Studies met inclusion criteria when they: 1) reported on at least five cases treated by one of the abovementioned techniques; 2) included children aged between twelve months and eight years; 3) presented a minimal follow-up of 24 months; 4) reported on radiological and/or clinical outcome according to the Severin's and McKay's score. We extracted data on patient characteristics, radiographic classification of dysplasia according to Tönnis', type of surgery, clinical and radiological outcome at last follow-up. Radiological and clinical outcomes were dichotomized into favorable and unfavorable outcome and weighted summary rates were determined using metaanalysis models.

Results: From a total of 7391 articles, 48 level of evidence grade IV articles were included in our review. A total of 2143 cases with a mean follow up of 112,4 months were included. Pooled Severin score indicated a statistically better outcome for PPO and DA compared to SIO (p=0.0003 and p=0.002, respectively). By dichotomizing the results in favorable and unfavorable outcome, PPO showed the best results (p=0.0002 vs. SIO, p=0.01 vs. DA). Pooled McKay score showed a statistically better outcome for PPO and DA compared to SIO ($p < 0.0001$ and p=0.03, respectively) as well as better outcomes for PPO compared to DA (p=0.01). By dichotomizing the results in favorable and unfavorable, PPO showed the best results.

Conclusions: Our review demonstrates slight better radiological and clinical results with the Pemberton pericapsular osteotomy. Due to the low level of evidence of the retained articles, these data needs to be interpreted with caution.

Level of evidence: IV

FM128

A modified single retrograde intramedullary nail technique for treatment of displaced proximal humeral fractures in children: Case series and review of literature. *(8245)*

Dr Eri Samara[1]; Dr Benjamin Tschopp; Dr Barbara Kwiatowski; Dr Nicolas Lutz; Prof. Dr Pierre-Yves Zambelli

[1] CHUV -Centre hospitalier universitaire vaudois

Introduction and objectives: Displaced proximal humerus fractures in children approaching skeletal maturity need to be reduced and fixed. The options for stabilizaton are many, including external fixation, rigid internal fixation with screws and plates, percutaneous pinning and flexible intramedullary nailing. Two flexible retrograde nail technique, originated at the University of Nancy, France became the most popular in Europe. The aim of this study is to describe a modified single retrograde nailing technique and to evaluate clinical and radiological outcome in children treated with this method.

Materials and Methods: From June 2016 to May 2019 a modified retrograde nail technique with one pre-curved nail filling at least 60% of the intramedullary humeral cavity was used for the management of 22 consecutive children with closed displaced proximal humeral fractures. The average surgical time and perioperative complications were used as criteria of feasibility of this technique. Patients were followed radiographically and clinically for at least 6 months. The radiological outcome were assesed by angulation and fracture displacement on 6 week and 6 month postoperative anteroposterior and axial shoulder radiography comparing to the preoperative. The clinical outcomes were assessed by documented shoulder range of motion in the medical folders and by using the French edition of the QuickDash evaluation scale at 6 weeks and 6 months postoperatively.

Results: Operative and postoperative complications did not occur. All treated fractures healed without loss of reduction. All patients had excellent results according to QuickDash Score, normal range of motion and excellent strength of the shoulder joint.

Conclusions: The single retrograde intramedullary nail technique represents an efficient method for the treatment of severely displaced proximal humerus fractures in this case series. Excellent functional and radiological results are reported. Multicentric, prospective studies are recommended to better evaluate this technique.

FM129

Allograft bypass combined with long term bracing in the treatment of congenital tibial dysplasia – mid- term results *(8437)*

PD Dr. Andreas Krieg[1]; Dr. Chao Dong[2]

[1] Universitäts-Kinderspital beider Basel; [2] Universitäts-Kinderspital beider Basel (UKBB)

Introduction: Congenital pseudarthrosis of the tibia (CPT) is a challenging disease process for both affected patients and paediatric orthopaedic surgeons. In the literature review a variety of treatment regimens have been reported with the outcome being just as variable. In this report, we will present the outcome in treating congenital pseudarthrosis of the tibia with an allograft bypass combined with long term bracing technique (Modified-McFarland Method).

Methods: This retrospective series includes 8 patients aged 19 - 42 months (mean: 2.4 years) with CPT treated between 2009 and 2018. The follow up (range 30 - 117 months, mean: 60 months) of all patients was at least 2 years. 5 out of 8 were Crawford type I (Crawford classifications), 2 were type II and 1 was type III. 2 out of 8 have experienced other CPT-related surgery before. 2 patients had already fractured and progressed to pseudarthrosis preoperatively. Re-operation, fracture and lower limb- function after operation were collected.

Results: All allografts were well incorporated in the patient's tibia at both ends. All 8 patients had full lower limb-function wearing protective orthotics. No amputation or infection has occurred until final follow up. Until final follow up, deformity in the coronal plane had been totally corrected with no obvious bowing in all cases. Two patients had a persisting 14° and 28° deformity in the sagittal plane. Complications included an allograft- and tibia-fracture which happened 3 years after operation and could be stabilized by allograft / internal fixation reconstruction.

Conclusion: Using Bypass technique in CPT patients can offer satisfactory results with regards to lower limb-function, preferentially if performed in patients without an established fracture or previous surgical intervention and at younger age. Distal tibia deformity can also be addressed at the same stage.

FM130

Osteoarticular infections in children: An update of Kingella Kingae epidemiologic, clinical and biological features. *(8502)*

Dr Benoit Coulin; Dr Giacomo De Marco[1]; Dr Tanguy Vendeuvre[1]; Dr Christina Steiger[1]; Dr Romain Dayer[1]; Prof. Dimitri Ceroni[1]

[1] Hopital Cantonal de Genève

Introduction: Osteoarticular infections (OAI) in children have long been studied, and the epidemiologic pattern is continuously evolving with the development of new technologies of identification such as PCR amplification. Where no causal microorganism could be found few years ago, bacterias are now identified. A precise knowledge of OAI semiology is the beginning of a better care for patients, considering that Kingella kingae (Kki) is currently the most prevalent pathogen in young children.

Methods: We present a monocentric retrospective study with a cohort of 335 OAI collected from January 2007 to December 2019. The epidemiologic, clinical and biological features of infections were gathered for each patient.

Results: We report 151 cases of Kki infections, 100 cases of bacteriologically confirmed infection and 51 cases, in which Kki was the highly probable etiology of the OAI owing to the result of oropharyngeal PCR assay, laboratory data, and positive MRI. When only considering the results of the 208 bacteriologically confirmed cases, Kki was responsible for 48.7% of osteoarticular infections and it was the main reported microorganism before the age of 36 months (79% of cases). Boys and girls were equally affected with the highest prevalence from the age 7 to 21 months. Kki was not found before the age of 7 month and only 4 cases older than 4 years old. The incidence throughout the year was not significantly different. On MRI qualification, we noted 53% of articular involvement affecting mostly the knee and 31% of osteomyelitis located primarily to the foot. Three-quarters of patients with OAI caused by Kki were afebrile at time of admission, and only 11% of them had elevated WBC. CRP was normal in 38%, whereas ESR was abnormal in 75% and constituted the most significant criteria predictor of an OAI.

Conclusion: We present one of the largest serie of OAI caused by Kki present in the literature to date. We confirm the literature showing that before the age of 36 months Kki should be recognized as the primary pathogen causing OAI. Our study demonstrates that the diagnosis of Kki osteoarticular infection in young children must be suspected, because it is often characterized by a mild to moderate clinical and biological inflammatory response; absence of fever and normal WBC do not exclude an OAI caused by Kki. Finally, this study demonstrates that PCR assays should be used in routine microbiologic laboratory evaluation to improve diagnostic performance.

FM131-FM141: INFECTIONS

FM131

Reasons for High Failure Rates in the Treatment of Streptococcal Periprosthetic Joint Infections: Results from a Single-Center Retrospective Cohort Study *(8197)*

Dr. Octavian Andronic[1]; PD Dr. Yvonne Achermann[2]; Dr. Thorsten Jentzsch[1]; Dr. Flurin Bearth[1]; Tanja Gröber[1]; Prof. Dr. Annelies Zinkernagel[2]; PD Dr. Stefan Rahm[1]; PD Dr. Patrick Zingg[1]

[1] Balgrist University Hospital, University of Zurich; [2] University Hospital Zürich, University of Zürich, Switzerland

Background: Current data suggest high relapse rates in streptococcal PJIs (periprosthetic joint infection). There are conflicting results regarding the role of the rifampin and the surgical management.

Methods: A retrospective analysis of consecutive series of streptococcal PJIs between February 2011 and February 2019 was performed. PJI was defined according to the Musculoskeletal Infection Society 2013 criteria. An infection-free outcome was defined as no revision surgery for septic reasons, no sinus tract, and no need for suppressive antibiotics at least 12 months after surgery. The outcome was compared to the outcome of the prospective PJI cohort (which included all pathogens) from the same institution.

Results: Twenty-two patients with confirmed streptococcal PJIs were included. All had an acute presentation. The most common isolated streptococcal species were Streptococcus dysgalactiae (9/22, 41%) and Streptococcus mitis (7/22, 32%). Surgical treatment consisted of DAIR (debridement, antibiotics, irrigation, and retention) in 12 (55%), one-stage revision arthroplasty in 1 (4%), two-stage revision arthroplasty in 8 (37%), and implant removal in 1 (4%) patient. The average antibiotic treatment duration was 82 days (range 38 – 133). Two patients relapsed under continued antibiotic treatment after DAIR. An infection free-outcome was achieved in 15 cases (68%), whilst 7 (32%) patients failed initial revision and relapsed with the same pathogen, six treated with an additional DAIR and one with one-stage revision arthroplasty. Three out of 7 patients with a relapse, remained under suppression antibiotic treatment. No failures were observed in patients who received a two-stage revision. Failure rates did not statistically differ in the cases treated with rifampin (1/5) from those without 6/17 (p=0.55). In all failures, a persistent distant infection focus was identified at time of relapse. Compared to our prospective PJI cohort, relapse rates were significantly higher 32% vs 12% (p <0.05).

Conclusion: Our data confirms the high relapse rates (32%) of streptococcal PJI in a consecutive retrospective cohort. We did not find any significant correlation with the use of rifampin or length of antibiotic treatment. However, no failures were observed in patients who received a two-stage revision, which may be the surgical treatment of choice. A distant persisting infection focus could be the reason for PJI relapse with recurrent hematogenous seeding in the joint.

FM132

Bone transport with the fully inserted Precice system (Nuvasive) *(8309)*

Prof. Dr. G. Ulrich Exner[1]; Dr. Tobias C. Bühler[2]; Dr. Pascal A. Schai[3]; Dr. Natasha Forster[4]

[1] Orthopädie Zentrum Zürich; [2] Kantonspital Baden; [3] Kantonspital Luzern Wolhusen; [4] SWISSPARC

Introduction: For the reconstruction of segmental bone defects an externally driven fully inserted transport nail has been developed (Precice system, Nuvasive). We had the privilege of using one of the first nails provided for the reconstruction of large bone defects. We wish to communicate our experience including the complications encountered and draw attention to this new technical possibility.

Methods: The 33 year old patient suffered a pathologic fracture of the left tibia 18 days after biopsy of the high grade osteosarcoma already under chemotherapy. The fracture was initially stabilized by an external fixateur (Monotube). After completion of the preoperative chemotherapy according to EURAMOS protocol, a segmental diaphysial resection of 7.5 cm was performed and the Precice Tibia Bone Transport Nail inserted.

Results: When 4 cm of transport were reached the patient developed septicemia related to the Port-a-Cath and concomitant implant-associated infection of the nail with osteomyelitis. This made removal of the nail with change to external ring fixation necessary. At the same time a cement spacer was inserted into the also infected tumor resection defect. Unnoticed until the postoperative X-ray documentation the motor part of the transport nail had disloged from of the nail during removal and remained inside the distal shaft, needing subsequent revision 2 weeks later to control the infection. The cement spacer was removed 8 weeks later and the 3.5cm defect filled with autologous bone from both posterior iliac crests. Further recovery so far is uneventful. No persistence of tumor locally or metastases at 14 months after diagnosis.

Conclusion: This new first device allowing fully closed bone transport greatly expands our armamentarium for treating segmental bone defects. Following the observation of desintegration of parts of the nail adaptation have been implemented by the producer.

FM133

Bioglass as a bone graft substitute in adults presenting non-unions or osteomyelitis: a retrospective study. *(8322)*

Hajdi Rama; Dr Sylvain Steinmetz[1]; Prof. Dr Olivier Borens[1]

[1] CHUV -Centre hospitalier universitaire vaudois

Introduction: Bioglass (BG) is a bioactive material with osteoconductive, osteostimulative, angiogenic and antibacterial properties. It is an alternative to autologous bone graft and indicated for the treatment of bone defects, non-unions and osteomyelitis. The aim of our study is to demonstrate that in adult patients treated by surgical debridement for non-union or osteomyelitis, the use of BG as bone substitute improves consolidation. Our primary outcome was the consolidation rate after the implantation of BG in a bony defect. Secondary outcomes were the absence of revision surgery and the infection eradication rate.

Methods: We conducted a retrospective study on all patients treated with BG for non-union or osteomyelitis. Surgical debridement was performed, and the resulting cavity was filled with BG (Bonalive ®). Patients were followed-up clinically and radiologically at 1 month, 3 months, 6 months or more after the operation. Patient's data were evaluated through the analyses of medical records.

Results: We analysed 30 patients, mean age was 47 years (18 – 84). Mean follow-up was 19.8 months. Fifteen patients had BG put in the defect alone (3 aseptic non-unions, 7 septic non-union, 5 osteomyelitis), 8 patients were treated by BG and autograft (4 aseptic non-unions, 3 septic non-unions), 7 patients were treated by BG and allograft (5 aseptic non-unions, 2 septic non-unions, 1 osteomyelitis). Consolidation was achieved in 19/30 patients (63%). When treated with BG alone consolidation rate was 73% (11/15), whereas when treated with BG and autograft it was 50% (4/8) and 57% (4/7) when BG and allograft were put in the defect. Twenty-two patients (73%) had no surgical complication. Four secondary infections were reported. None was found in patients treated with BG alone, three cases in patients treated with BG and autograft and one in a patient treated with BG and autograft. BG had to be removed in eight patients.

Conclusion: Consolidation rate was 63% (19/30) in all the patients and 75% (11/15) when treated by BG alone. Our results are comparable to the those of other clinical studies. Consolidation was not improved when BG was mixed with autograft or allograft. We demonstrated encouraging results with the use of BG in septic sites.

FM134

How good are clinicians in the visual and olfactory prediction of Pseudomonas spp. in diabetic foot infections? - A prospective clinical pilot evaluation *(8347)*

Dr. Tudor Trache; Dr. Madlaina Schöni; Dr. Peter Kahr; Dr. Fabio Casari; Dr. Fabio Weber; Dr. Jan Burkhard; Dr. Felix Waibel; Dr. Thomas Böni; Dr. Dominique Holy; Dr. Martin Berli; PD Dr. Ilker Uckay

Universitätsklinik Balgrist

Introduction: Routinely used antibiotic agents for community-acquired mild and moderate diabetic foot infections (DFI) are aminopenicillins and 2nd generation cephalosporins not covering the rather uncommon Pseudomonas spp. Many orthopedic surgeons and internists claim to be able to predict pseudomonal infection by visual and/or olfactory means. There are no data on that assumption.

Methods: Prospective observational pilot study involving clinicians with at least five years' experience in the therapy of DFI, which were not briefed for the study. We defined Pseudomonas infection by the results of deep/intraoperative microbiological cultures and/or clinical remission of DFI achieved with non-pseudomonal antibiotic agents. We excluded cases with known microbiological results and uninfected foot ulcers. P. aeruginosa was specifically sought in polymicrobial DFIs.

Results: We included 85 evaluations of community-acquired DFI in 51 adult patients. We separately asked 7 experienced clinicians (4 orthopedic surgeons, 2 internists, 1 Infectious Diseases specialist) to assess Pseudomonas spp. involvement. In 18 cases, Pseudomonas was predicted. The principal predictors were green color, macerated skin and specific smell. The visual and olfactory interpretations correlated in 12 cases. In other 6 cases, visual determination (N=4) and olfactory assessment (N=2) were preferred. The cultures grew Pseudomonas in 13 cases (7 bone samples), in 4 as mono-infection and in 9 as a mixed-infection. The clinicians predicted Pseudomonas incorrectly in 13 cases, correctly in 5, and missed it in 8 evaluations. The sensitivity, specificity, positive and negative predictive values for Pseudomonas were 0.38, 0.83, 0.29, and 0.88, respectively. The values of the surgeons alone were 0.50, 0.94, 0.75, and 0.84. Cultures for false-positive predictions showed other non-pseudomonal Gram-negatives in 46%. In cases with false-negative predictions, no non-pseudomonal Gram-negatives were detected, despite Pseudomonas-positive cultures, arguing against a relevant confounding effect by other Gram-negatives for Pseudomonas prediction.

Conclusion: The clinical predictive capacity for Pseudomonas in community-acquired DFI among clinicians was moderate, with a trend to overestimate pseudomonal DFIs. The clinical consequences and a potential awareness/training effect over time, the performance of wound nurses, and the accuracy of such clinical predictions for non-diabetic foot infections need further

FM135

Statin Medication Associated with Complications After Orthopedic Surgery? The First Insights in a Large Epidemiological Cohort-Study *(8395)*

Dr. Ines Unterfrauner; Dr. Maurits Olthof; Peter Jans; Regula Schüpbach; PD Dr. Ilker Uçkay; PD Dr. Michael Betz

Balgrist University Hospital

Introduction: Besides lowering serum cholesterol levels, several in vitro and animal studies demonstrate an anti-inflammatory and anti-bacterial effect of chronic statin medication. Furthermore, we know that statin therapy can decrease postoperative surgical site infections (SSI) in cardiac surgery and prevent femoral osteolysis in total hip arthroplasty. We investigate the association between preoperative statin use, SSI and other revision interventions in orthopedic patients.

Methods: We performed a cohort study, including all adult patients undergoing first-time orthopedic surgery, for any indication but infection, at Balgrist University Hospital between January 2014 and March 2019 (n=20,088). Patients with confirmed infection prior to surgery were excluded. The primary outcome was the occurrence of SSI in relation with statin medication. Secondary outcomes were unplanned revisions due to various non-infected complications.

Results: We included 20,088 episodes of non-infected orthopedic surgeries, of which 2,486 with preoperative statin therapy and 17,602 without. The mean age was 52 years (range 18-97 years, 50.6% males, average BMI 26.8 kg/m2, 5% diabetic patients). In total, 1'414 episodes (7%) required revision surgery, of which 11% due to SSI (n=158). The mean time delay from the index intervention to revision surgery was 310 days (range 0–1736 days). The mean length of hospital stay was 4 days (range 1-198 days). In crude group comparisons, statin users yielded a higher SSI risk than non-users (Pearson's chi2-test; 1.3% vs. 0.7%, p=0.01). The revision risk due to non-infectious reasons was equally higher in the statin group (7.2% vs. 6.1%, p=0.01). In multivariate logistic regression analyses adjusting for the large case-mix, statin use was unrelated to SSI (odds ratio (OR) 0.9; 95% confidence interval 0.5-1.4). Regarding the non-infectious surgical revisions, a prior statin use was equally unrelated (OR 1.0, 0.9-1.2); in contrast to a higher BMI (as a continuous variable; OR 1.02, 1.01-1.03) or diabetes mellitus (OR 1.3, 1.04-1.72) favoring revisions.

Conclusion: Our large single-center cohort pilot evaluation failed to reveal a protective effect of statin medication on SSI or on other revisions. Cox regression models, stratified analyses on the surgery type, statin agents and doses, and propensity score-matched analyses are under way.

FM136

Surgical site infections at donor and recipient sites in patients with iliac crest harvesting for autologous bone grafting *(8397)*

Dr. Ines Unterfrauner; Dr. Maurits Olthof; Peter Jans; Regula Schüpbach; PD Dr. Michael Betz; PD Dr. Ilker Uçkay

Balgrist University Hospital

Introduction: Orthopedic surgeons harvest the iliac crest for autologous bone grafting. This iliac site rarely becomes infected. The epidemiology of this type of surgical site infection (SSI) is unknown.

Methods: We conducted a cohort study including all adult patients undergoing first-time orthopedic surgery at Balgrist University Hospital between January 2014 and March 2019. We excluded patients with infection prior to index surgery, pediatric cases, episodes of diabetic foot syndromes and superficial SSI not requiring surgical revision. The primary outcome was SSI incidence at the iliac crest sampling site. We further investigated if patients with iliac bone harvesting yield more SSI at the primary surgery site, or revealed more risk factors for orthopedic SSI such as diabetes mellitus, longer total duration of surgery, operated cancer, a higher ASA-score, or a high body mass index (BMI).

Results: Overall, we included 20,088 episodes of orthopedic surgery, of which 467 with iliac crest bone sampling (467/20,088; 2%). Among this latter group, only two iliac sites (2/467; 0.4%) became infected. With so few numbers, we were unable to perform group comparisons or multivariate analyses specific for iliac SSIs. Regarding risk constellations, surgeries with supplementary iliac crest sampling yielded more SSIs at the primary operation site than those without (1.9% versus 0.8%; Chi2-test; p <0.01). However, these patients did not reveal more co-morbidities at risk such as diabetes mellitus (6% vs. 5%), local cancer surgery (2% vs. 3%), higher age (median 50 vs 53 years), higher BMI (median 25 vs. 26 kg/m2), higher ASA-score (p=0.17) and had a similar total duration of surgery (median 1: 20 h vs. 1: 20 h); when compared to the general orthopedic population.

Conclusion: In our single-center cohort with 20,088 orthopedic interventions, the SSI risk of the iliac harvest site is low, and even lower than the risk for SSIs in the primary operation site. Surgeries with supplementary iliac crest harvesting, however, revealed a significantly higher SSI risk despite a similar proportion of classical co-morbidities for SSIs. Further analyses are under way.

FM137

Doubling of perioperative antibiotic prophylaxis for obese orthopedic patients – first outcomes of a "before-after study" *(8415)*

Dr. Anita Hasler[1]; Dr. Ines Unterfrauner; Dr. Maurits Olthof; Peter Jans; PD Dr. Yvonne Achermann; Prof. Dr. Ilker Uckay

[1] Universitätsklinik Balgrist

Introduction: Obesity is an independent risk for surgical site infection (SSI) in adult orthopedic patients. Based on retrospective data and pharmacology, many centers adopted a weight (>80 kg) and/or a body mass index (BMI >30 kg/m2)-related doubling of prophylactic antibiotic doses to prevent SSIs. However, this attitude has not been clinically evaluated.

Methods: The (*blinded*) Hospital introduced a weight-adapted antibiotic prophylaxis (double doses of cefuroxime, clindamycin or vancomycin) on 27.3.2017 for patients >80kg. We use an all-orthopedic cohort (before-and-after-study) for the time periods 27.3.2016 -26.3.2017 (Period 1 "no weight-adapted") and 27.3.2017-26.3.2018 (Period 2 "weight-adapted"); with a passive follow-up of almost one year. We excluded episodes without prophylaxis, infected patients, revision surgeries, or oncologic surgeries. The primary outcome was SSIs in relation to the time period and other clinical associations with SSIs.

Results: We compared 3199 surgeries in Period 1 to 3370 interventions in Period 2. Baseline demographics were similar (Table 1): mean age 53 years vs. 53 years; 49% females vs. 50%; BMI 26.8 kg/m2 vs. 27.0 kg/m2 (p=0.16). The periods only differed in the proportion of diabetic patients (7.2% vs. 3.7%; p <0.01) and the duration of surgery (mean 86 minutes vs. 91 min.; p <0.01). In crude comparison, the SSI incidence was similar for both periods with 0.84% (n=27; Period 1) and 0.97% (n=33; Period 2) (Pearson-Chi2-test; p=0.08). Equally, we found no difference when stratifying for a BMI >30 mg/m2: SSI 0.92% vs. 1.39% (p=0.48).

Conclusions: In this first (pilot) analysis of a single-center before-after-study over 6000 uninfected orthopedic surgeries, the systematic doubling of the perioperative antibiotic prophylaxis for a weight >80 kg failed to reduce SSIs risks in our clinic. Larger population, time-dependent, propensity-score-matched, and more stratified analyses are under way.

FM138

Long-term survival at 5 years after below knee amputation and predictive factors of mortality: retrospective study *(8497)*

Dr Coraline Zhiti[1]; PD Dr François Luthi[2]; Philippe Vuistiner[2]; Dr Stéphane Cherix[3]; Prof. Dr Olivier Borens[3]; Dr Sylvain Steinmetz[1]

[1] CHUV, Centre Hospitalier Universitaire Vaudois; [2] Clinique romande de réadaptation Suva Sion; [3] CHUV Cente Hospitalier Universitaire Vaudois

Introduction: Below-knee amputation ("BKA") is a transtibial amputation (Burgess). Patients with BKA have a high mortality rate, about 40% to 82%, despite the progress of modern medicine. This is of major health concern and we are not able to clearly identify the predictive factors of mortality. The aim of the study was to determine the survival rate after BKAs with a minimum 5 years follow-up and to identify predictive factors.

Methods: A retrospective review was conducted on all adult patients undergoing BKA from September 2007 to December 2014 in an University Hospital. Demographic and clinical data, perioperative data and out-

comes were collected and analyzed to identify any relationship with mortality. The primary outcome was the survival rate at 5 years. Date of patient's death was collected using the federal register. The secondary aim was to determine predictive factors for mortality. We collected age, ASA score, and comorbid conditions including diabetes (type I, II and insulin resistance), coronary artery disease, chronic kidney failure (CKF) (dialysis or not), and active smoking. Associations with survival time were evaluated using Cox regressions.

Results: During the study period, 98 patients (70% male, mean age 66 years) were treated with BKA. Surgical indications were vascular (63 patients), infection (20 patients), trauma (7 patients), tumor (3 patients), fasciitis (1 patient) and complications after previous amputations (4 patients). Sixty-three patients (64.3%) died. The survival rate is 35,7% at 5 years. During the 5-year follow up two factors were associated with a longer survival time, ASA score of 2 (HR= 0.17 ; 95% CI, 0.04 – 0.70) and prosthesis wearing (HR= 0.25 ; 95% CI, 0.14 – 0.44). ASA score>3, CKF and dialysis were predictive factor of mortality, p<0.20. We found no variations in mortality with smokers, diabetes, and coronary artery disease.

Conclusion: BKA continues to be associated with considerable mortality, the survival rate at 5 years being 35,7%. Our survival rate at 5 years is similar to the literature. In this study, ASA score<3 and prosthesis are predictive factors of survival.

FM139

Complication after open reduction and internal fixation of ankle fracture: a consecutive monocentric review of 305 cases. *(8499)*

Anaïs Luyet; Prof. Dr Xavier Crevoisier; Dr Eric Thein; Prof. Dr Olivier Borens

CHUV -Centre hospitalier universitaire vaudois

Introduction: Ankle fracture is a common orthopedic condition, accounting for 9% of all fractures. Despite a relatively simple operating technique, this surgery is often associated with early complications up to 8%, such as wound healing problems, poor reduction and infection. We carried out a review of the open reduction et internal fixations (ORIF) performed in our center in order to analyze our complication rate and compare our results to the literature.

Method: This is a retrospective monocentric study of all the patients undergoing ORIF of ankle fractures (AF) between 2017 and 2019 in our department. We classified the cases by ORIF type and reviewed the complications within 3 months after index surgery.

Results: 305 ORIF were performed between 2017 and 2019 (38% in 2017, 31% in 2018 and 31% 2019). The number of trimalleolar fixation increased from 12% in 2017 and 11% in 2018 to 32% in 2019. 2.3% were open fractures Gustilo 2, 11.2% were fracture-dislocation and 4.6% required an external fixation at first. 45.5% of the cases were operated on by seniors and 54% by senior residents equally for each type of ORIF. The mean operating time is 124±52 minutes and similar for senior residents and attending surgeons, from 70 minutes for a single malleolus to 172 minutes for a trimallolar ORIF. 6.5% patients required revision surgery within 3 months (7.8% in 2017, 5.1%in 2018 and 6.5% in 2019). 3.3% required surgery to remove the trans-syndesmotic screws,1.3% needed surgery due to malalignment and 2% for early infection. There is no statistical difference over the years. The infectious cases were all polymorbids patients. 3 were treated by debridement and retention, 1 was treated by external fixator, 1 by transient calcaneo-tibial arthrodesis and 1 required a below knee amputation due to poor soft tissue coverage after 6 débridement surgeries and a free flap. 50% were polymicrobial infections with 66% Enterococcus cloacae, 33% Pseudomonas aeruginosa and 33% Staphylococcus aureus. No predictive factor such as length of surgery or type of surgeon involved were found for malreduction or infection.

Conclusion: The literature reports early complication rate up to 8% and infection rate from 1.6% to 4.4%. Our data are similar. Despite its frequency failed ankle surgery can have devastating outcomes and lead up to amputation. Good patient choice and adapted surgical technique are paramount.

FM140

Outcome of streptococcal prosthetic-joint infections *(8550)*

Dr Arnaud Fischbacher; Dr Sylvain Steinmetz; Dr Loïc Lhopitallier; PD Dr Noémie Boillat-Blanco; Prof. Dr Olivier Borens

CHUV -Centre hospitalier universitaire vaudois

Introduction: Streptococci cause around 10% of prosthetic-joint infections (PJI). The reported treatment success being poor, antimicrobial recommendations vary regarding its duration and the use of long-term suppression. We aimed to assess the treatment success rate of streptococci PJI without antimicrobial suppression over the last thirteen years.

Method: We included patients with streptococcal PJI at Lausanne University Hospital (Switzerland) between 2006 and 2019 in a retrospective cohort. We compared the treatment success rate according to streptococci species and type of surgical procedure.

Results: In our cohort we have 635 PJI out of which 69 (11%) were caused by streptococci (S. agalactiae 32%, viridans group 23%, S. dysgalactiae 17%, S. pyogenes 8%, S. anginosus 8%, S. bovis 5%, S. pneumoniae 5%). Sixty percent had a hip infection, 40% a knee infection and the median age was 70 years. Two-step exchange was performed in 55%, débridement and retention (DAIR) in 42% and one-step exchange in 3% of the patients. The overall treatment success rate was 80%. The median time to failure was 8 months (CI 0.5-43 months). The success rate was better for two-step exchange compared to DAIR (90% versus 64%, p=0.01). Infections caused by Streptococcus dysgalactiae were associated with a higher failure rate (two-step success rate 67%, DAIR 25%, p=0.009).

Conclusion: The treatment success of streptococcal PJI does not seem to be worse arguing against the systematic use of long-term antimicrobial suppression. However, our results suggest that surgical management with two-step exchange and long-term antimicrobial suppression might be useful in selected patients' groups such as those with Streptococcus dysgalactiae PJI.

FM141

Prosthetic-joint infections after hip hemiarthroplasty for femoral neck fracture *(8553)*

Dr Arnaud Fischbacher; Dr Matthias Vautrin; Dr Sylvain Steinmetz; Dr Julien Stanovici; Prof. Dr Olivier Borens

CHUV -Centre hospitalier universitaire vaudois

Introduction: Prosthetic-joint infections (PJI) after hip hemiarthroplasty for femoral neck fracture represent a serious complication in terms of morbidity and mortality with an incidence ranging from 5 to 17%. We aimed to assess the incidence of infection and the treatment success rate over the last two years.

Method: We included patients with a hip hemiarthroplasty for femoral neck fracture at Lausanne University Hospital (Switzerland) between January 2018 and October 2019 in a retrospective cohort. Primary outcome was the infection rate and secondary the treatment success rate at three months.

Results: In our cohort we have 241 patients operated for a hip hemiarthroplasty with a median age of 85 years, a 1: 1.8 males to females sex ratio and a median ASA score of 3. Eight patients (3.7%) had prolonged wound leakage, known as a risk factor for PJI, and underwent therefore débridement and retention (DAIR). Five out of the 8 were positive for infection resulting in an infection rate of 2.3%. We had no treatment failure after a three months antimicrobial treatment.

Conclusion: Prosthetic-joint infection after hip hemiarthroplasty remains rare. However, prolonged wound leakage is more common and must undergo débridement and retention in order to prevent or treat an infection.

FM142-FM149: TUMOURS

FM142

Impact of Titanium vs. Carbon-PEEK Implants on post-operative Photon-Radiation-Therapy following Spinal Tumor Surgery - A pre-clinical Phantom Model Study *(8286)*

Dr. Moritz C. Deml[1]; Dr. Peter Manser[2]; Prof. Dr. Lorin M. Benneker[1]; Prof. Dr. Daniel Aebersold[3]; Dr. Hossein Hemmatazad[3]; Dr. Dario Terribilini[2]; Dr. Norbert Klippel[2]

[1] Inselspital, Department of Orthopaedic and Trauma Surgery, University Bern; [2] Inselspital, Division of Medical Radiation Physics, University Bern; [3] Inselspital, Department of Radiation Oncology, University Bern

Background: Metal implants create artefacts in radiation planning CTs after spine surgery due to tumor diseases. Image quality is compromised and therefore contouring and dose calculation in radiation therapy is affected. Implants made from carbon fiber reinforced poly-ether-ether-ketone (CFR-PEEK) are radiolucent and therefore do generate less artefacts on CT. We investigated the effect of titanium vs. CFR-PEEK implants on the photon-radiation process after spine surgery in a phantom model.

Methods: An antropomorphic upper body phantom with the following four interchangeable implant-inserts were created: (1) Native spine, (2) titanium pedicle-screw-system with titanium anterior vertebral body replacement, (3) full CFR-PEEK pedicle-screws with an anterior CFR-PEEK vertebral body replacement and a (4) CFR-PEEK pedicle-screws with titanium tulips and an anterior carbon-PEEK vertebral body replacement. After CT scans, planning target volumes (PTV) were contoured for the following cases: (1) A palliative setting with the spinal cord included in the PTV, (2) a spine metastasis with paraspinal tumor extension irradiated with curative intent and sparing the spinal cord. Conformal plans and volume modulated arc therapy (VMAT) plans with a fraction dose of 2 Gray were created with the Varian Eclipse planning tool. All radiation plans used 6 MV photons and were applied on a Varian Unique linac. The dose distribution close to the implants with Gaf-Chromic dosimetric films in a frontal plane of the phantom, levelled to the spinal cord was evaluated.

Results: In the palliative radiation-setting dose deviations of up to 20% were seen in titan implants, comparing to the native spine. The treatment planning system is not able to reproduce this behaviour. The effect becomes smaller with increasing complexity of the applied treatment plans: In a conformal plan consisting of two dorsal fields, the measured dose deviation for the titanium implant is 10%. The applied VMAT plans were less influenced by all kind of implants. For pure CFR-PEEK, dose deviations are lower than 5% for all setting. CFR-PEEK implants lead to very similar dose distributions compared to calculations without implants.

Conclusion: Titanium implants cause measureable dose deviations in post-operative spinal radiation therapy, which depend on radiation plan complexity. Implants made from CFR-PEEK can minimize these deviations.

FM143

Prognostic Significance of Texture Analysis of Magnetic Resonance Images in Primary Osteosarcoma *(8315)*

Dr. Christoph J. Laux[1]; Sandro M. Hodel[2]; Prof. Dr. Beata Bode-Lesniewska[3]; Dr. Benjamin Fritz[1]; PD Dr. Daniel A. Müller[1]

[1] Universitätsklinik Balgrist; [2] Kantonsspital Baden; [3] UniversitätsSpital Zürich

Introduction: The histopathological response to neoadjuvant chemotherapy is the best-established prognostic factor in primary osteosarcoma. However, patients with poor response to neoadjuvant chemotherapy cannot be identified prior to histopathological examination of the resected specimen and risk stratification thus is only possible after surgical tumour removal. Texture analysis is an emerging tool enhancing the diagnostic performance of medical imaging. This study aims to investigate the prognostic performance of MRI texture analysis in order to earlier identify patients at risk of poor outcome.

Methods: Native T1-weighted MR images of 25 patients with conventional high-grade osteosarcoma prior to neoadjuvant chemotherapy were analysed retrospectively. A three-dimensional quantitative texture analysis was performed after manually defining volumes of interests. The texture analysis features were fitted into a statistical model for unsupervised machine learning in order to predict histological subtype, response to neoadjuvant chemotherapy and long-term survival.

Results: The model predicted a good response to chemotherapy (Salzer-Kuntschik grades I to III) with a sensitivity of 56% and a specificity of 63% (PPV 71%, NPV 45%). A disease-specific event within 2 years after surgery was predicted with a sensitivity of 50% and a specificity of 67% (PPV 40%, NPV 75%). Histological subtypes failed to be reliably predicted.

Conclusion: Our statistical model showed a moderate predictive performance, especially when attempting to predict long-term outcome. This, however, is probably due to the small sample size. Therefore, larger series are needed to confirm the prognostic value of texture analysis in primary osteosarcoma.

FM144

The influence of patient position on preoperative 3-D planning of resection of subfascial soft tissue tumors in the lower extremity- a pilot study using cadaver legs *(8381)*

Dr. Dominik Kaiser; Dr. Armando Hoch; Dr. Philipp Kriechling; Dr. Dimitri Graf; Dr. Felix Waibel; PD Dr. Daniel Müller

Balgrist Universitätsklinik

Introduction: Soft tissue sarcomas of the extremities are a rare but often highly-malignant disease. If possible, a limb sparing surgical resection is preferable to an amputation for functional and psychological reasons. The minimal distance of the soft tissue tumor to relevant neurovascular structure as seen on MRI determines if a limb-sparing approach can be pursued. Achieving a tumor free resection margin is of great importance as it is associated with a markedly lower local recurrence rate. Preoperative planning of tumor resection is mainly performed on MR images which are obtained in supine position, while the surgery may be performed in a different patient position. The goal of this cadaver study was to investigate the influence of patient position on the minimal distance of a simulated soft tissue tumor to important neurovascular structures in cadaver legs.

Material and methods: Two fresh frozen cadavers (pelvis and legs) were thawed and warmed. Three "soft tissue tumors" (water saturated sodium polyacrylate in a cotton envelope) were implanted in the posterior/anterior thigh and posterior calf of the four legs. MR images of the cadaver legs were obtained in supine position, right lateral decubital position, prone position, left lateral decubital position, supine position. The minimal distance of each tumor to the important nerves, vessels, skin and bone were measured on axial MR images and compared to each other. To minimize the effect of external manipulation during the cadaver repositioning the two supine positions (position 1 and 5) were compared to each other.

Results: We noted a distinct influence of the patient position on the minimal distance of the tumors to the important anatomical structures. In contrast to bone tumors, the exact localization of soft tissue tumors intraoperatively depends on patient positioning. Our pilot study implies, that there is a mismatch between the MRI examination, which is always obtained in supine position, compared to the intraoperative patient positioning. This major impact has to be considered in future efforts to create exact 3D models of the tumor to facilitate the resection.

Conclusion: Preoperative planning on an MRI performed in the same position as the surgery may benefit the surgeon by more closely representing the effective position of the soft tissue tumor and its relation to important neurovascular structures.

FM145

Combined pedicled superficial circumflex iliac artery perforator (SCIP) flap with lymphatic tissue preservation and lymphovenous anastomosis (LVA) for defect reconstruction and lymphedema-lymphocele prevention in thigh sarcoma surgery: preliminary results *(8425)*

PD Dr. Mario Scaglioni[1]; Dr. Elmar Fritsche; Prof. Dr. Martin Beck; Dr. Carlo Theus; Dr. carmen huemmer; Prof. Dr. Bruno Fuchs

[1] Luzerner Kantonsspital Luzern

Background: Sarcoma surgery often requires large tissue resection to be safely treated. When the tumor is localized in the medial thigh, lymphocele and lymphedema are common complications because of the rich lymphatic network present there. The aim of this study is to share the outcome of seven patients who received defect reconstruction in this area with combined pedicled superficial circumflex artery perforator (SCIP) flap with lymphatic tissue preservation and lymphovenous anastomosis (LVA) for prevention of lymphatic complications.

Patients and methods: Seven patients who underwent surgical resection of sarcoma in the adductors compartment received defect reconstruction with pedicled SCIP flap combined with LVA. For a better dead space obliteration four of them also received an additional tissue flap: two pedicled deep inferior epigastric perforator (DIEP) flaps and two free anterolateral thigh (ALT) flaps. Indocyanine green (ICG) lymphography was performed in all cases to identify the lymphatic pathway, make the pre-operative marking and check the patency of the anastomoses.

Results: All the 7 patients were successfully treated reaching a good aesthetic result and full range of motion (ROM). No immediate or delayed complications such as lymphocele or lymphorrhea were observed during the follow up (range: 6-9 months; mean: 7.3) and no secondary procedures were required.

Conclusions: The combination of the pedicle SCIP lymphatic tissue transfer with LVA seems to be effective in preventing the development of lymphatic sequelae after large resections in the medial thigh.

FM146

Survivorship and clinical outcome of tumor prosthesis reconstruction in distal femur and proximal tibia *(8491)*

Dr. Chao Dong[1]; Dr. Carlo Theus[2]; PD Dr. Andreas Krieg[3]; PD Dr. Andrej Nowakowski[4]; PD Dr. Daniel A Müller[2]; Dr. Dominik Kaiser[2]

[1] Universitätskinderspital beider Basel (UKBB); [2] Balgrist Universitätsklinik; [3] Universitäts-Kinderspital beider Basel; [4] Spital Uster

Background: Distal femur and proximal tibia are the most common sites for primary malignant bone tumors. The tumor prosthesis is commonly used to rebuild the joint defect after tumor resection. Two national Sarcoma centers retrospectively reviewed the long-term results in 97 patients with knee tumor prosthesis reconstruction and evaluated risk factors associated with survivorship and clinical outcome of tumor patients.

Patients and methods: We retrospective reviewed 97 patients (age from 6 to 82 years, mean age 33.8 ± 21.6) with musculoskeletal tumor around the knee joint. All patients were treated by MUTARS® tumor prosthesis in 2 sarcoma centers from 1990-2017 in Switzerland. 56 of them were males. The most common pathological diagnosis was osteosarcoma (n=54, 55.7%). The overall median follow-up was 7.15 years Survivorship outcome will be evaluated by the overall survival (OS) and revision-free survival (RFS) (5 years and 10 years). Complications and failure were classified according to the Henderson classification. Function after the operation was evaluated by the Musculoskeletal Tumor Society (MSTS) score. Other major factors included tumor size, silver coating and cemented implants.

Results: The median overall oncological survival of all patients was 17.9 years. The 10-year overall oncological survival of all patients was 73.15% (95% CI 60.77- 89.60%). The median revision-free survival was 10.9 years. The 5-year revision-free survival was 79.81% (95% CI 61.35-92.08%) and 10-year revision-free survival was 57.06% (95% CI 31.42-76.19%). Prosthesis failure was observed in 31 cases (32.0%), 14 caused by aseptic loosening, 10 by structural failure, 5 by infection, 2 by soft tissue failure and 1 by tumor progression. Patients aged less than or equal to 40 years (p=0.0116) and with diagnosis with osteosarcoma (p=0.0390) showed a shorter survival time and higher failure rate. The prosthesis in cement/uncement and sliver coated/unsilver coated groups have no significant different. The mean Musculoskeletal Tumor Society (MSTS) score in the normal group was 25.8 (86.1%), ranging from 14 to 30 (46% to 100%) and in the revision group was 24.0 (80.0%), ranging from 14 to 30 (46% to 100%) (p=0.5570).

Conclusion: The age less than 40 years old and osteosarcoma at diagnosis were two risk factors for failure of knee tumor prosthesis in this research series. Knee around tumor prosthesis can achieve long-term limb s

FM147

Extraabdominal desmoid tumors – watchful waiting strategy *(8494)*

PD Dr. Andreas Krieg[1]; Dr. Chao Dong[1]; Prof. Dr. Christoph Kettelhack[2]; Prof. Dr. Daniel Baumhoer[2]; Prof. Dr. Beata Bode[3]; PD Dr. Frank Klenke[4]; Prof. Dr. Klaus Siebenrock[4]; Prof. Dr. G. Ulrich Exner[5]; Prof. Dr. Daniel A Müller[6]; Dr. Stephane Cherix[7]; Dr.

[1] Universitäts-Kinderspital beider Basel (UKBB); [2] Universitätsspital Basel (USB); [3] Pathologie Institut Enge; [4] Insel Spital Bern; [5] orthopaedie zentrum zuerich; [6] Balgrist Universitätsklinik; [7] Lausanne University Hospital (CHUV)

Introduction: Desmoid tumors (DT) are rare and histologically benign neoplasms with an unpredictable natural evolution, which can show functionally crippling local aggressivity. The traditional treatment by wide surgical excision yields a very high rate of recurrence of >40%. A first multicentric retrospective study of the different treatment modalities of DT in Switzerland confirmed the high risk of recurrence following surgery, and revealed that a high proportion of patients treated by "watchful waiting" had a stable disease, or could even show a spontaneous regression. The main goal of our next study was to specifically evaluate the natural evolution of this "watchful waiting" (WW) group of patients.

Methods: Multicentric retrospective study of patients with histologically proven extra-abdominal desmoid tumor, older than 14 years, initially treated by watchful waiting (WW), with a minimal follow up of 6 months before any intervention (surgery [biopsy excepted], radiation therapy or systemic treatment).

Results: 34 patients were included from 4 tumor centers. 27 patients were females. Mean age was 40.7 years (range 14-79 years). Mean follow-up was 4.6 (range 1.8-9.8 years). Among all patients, 21 patients (62%) had a stable (n = 13) / regression (n =7) disease with a continuation of the WW strategy, 13 patients (38%) required a change of the strategy because of progression (n =11) or pain (n = 2) after an mean of 18 months (range 6 – 78). The second treatment was in 9 patients systemic medical therapy and in 4 patients surgery and/or radiation. After these 11 of the 14 patients were continuously followed with "watchful WW strategy with Stable disease / Regression in a mean of 40 months follow up (range 4.8 – 84 months). 2 patients are still under ongoing systemic medical treatment and one patients had additional local therapy. Successful treatment was achieved in 91% of our patients with the two stage treatment approach.

Conclusion: Because the timing of diagnosis is unknown in relation to disease progression, an initial observation (WW) period should be considered in these patients after biopsy. Thus, quality of life should be the focus in treatment decisions. WW should be the first line treatment rather than surgery in DTs based on our results followed by further systemic treatment like chemotherapy / targeted therapies in case of progression.

FM148

Prognostic factors in lipomatous tumors: do we have to take lipoma-like tumors seriously? *(8548)*

Yves Scherrer; Dr. Christoph J. Laux; Tobias Götschi; PD Dr. Andrea B. Rosskopf; PD Dr. Daniel A. Müller

Universitätsklinik Balgrist

Introduction: Large lipomatous tumors are frequent in orthopedic oncology practice. Diagnostic problems are caused mainly by borderline tumors, called atypical lipomatous tumors (ALT) or low-grade liposarcomas. The distinction of lipoma from ALT is a well-known problem in soft tissue pathology, especially when the lesion shows >10 cm of size. The introduction of the MDM2 screening in tumor adipocytes improved the diagnostic reliability but necessitates a tissue sample. The aim of the

study was to find clinical and radiological factors for better identification of ALT/liposarcomas.

Methods: We retrospectively reviewed all patients with lipomatous tumors affecting the extremities or the trunk treated at our institution from January 2010 to December 2015. All patients preoperatively obtained a core needle biopsy for histological examination including the search for MDM2 amplification and a contrast-enhanced (Gadolinium) MRI. All patients had a follow-up of at least 2 years. The pre-treatment MRI was investigated for septations, inhomogeneity, fat content, local high T2 STIR signal and contrast enhancement within the tumor.

Results: A total of 104 patients were included in the study. In 73 patients, a benign lipoma was found, 11 patients had an ALT and 20 patients were diagnosed with a liposarcoma grade 2 or 3. We did not find a difference regarding age and gender for the distinction between lipoma, ALT and liposarcoma. The tumor volume was significantly higher in ALT and liposarcoma compared to lipomas (1150 cm3 versus 420 cm3; p=0.013). Whereas lipomas were found almost equally distributed at the upper (42%) and lower extremity (31%), as well as at the trunk (26%), ALT and liposarcoma had a significant higher occurrence at the lower extremity (84%; p=0.001). Analyzing the MRI, intralesional septations thicker than 2 mm, local high T2 STIR signal and contrast uptake were strong risk factors for ALT or liposarcoma. In the subgroup of ALT/liposarcoma, foci of high T2 STIR signal (p=0.021) and the presence of non-adipose masses (p=0.023) were associated with a higher local recurrence rate.

Conclusion: Size, anatomical location, intralesional septations thicker than 2 mm, local high T2 STIR signal and contrast uptake are risk factors for an ALT or even a liposarcoma. These clinical and radiological risk factors can be used to decide whether a preoperative biopsy is needed or not.

FM149

Osteoid osteoma and chronic osteomyelitis: clinical and radiological similarities can lead to misdiagnosis and inappropriate treatment - A case series and concise literature review. *(8569)*

Lucrezia Mencarelli[1]; Dr Thierry Rod Fleury[2]; Dr Michele Palazzuolo[1]; Dr Patrick Omoumi[1]; Dr Fabio Becce[1]; Prof. Dr Olivier Borens[3]; Stéphane Cherix[3]

[1] Lausanne University Hospital and University of Lausanne; [2] Hôpitaux universitaires de Genève (HUG); [3] Lausanne University Hospital and University of Lausanne (CHUV)

Introduction: Osteoid Osteoma (OO) accounts for 11% of benign bone tumours. It typically affects long bone diaphysis of men under 40 y.o. and is characterized by severe chronic inflammatory pain, increasing at night, usually promptly relieved by NSAIDs. Computed tomography (CT) is the gold standard imaging modality, where OO shows up as a radiolucent <2cm nidus, surrounded by intense osteosclerosis and periosteal reaction. The treatment of choice is percutaneous Radio Frequency Ablation (RFA). Usually, a biopsy is made just before RFA for histological confirmation of the diagnosis. In rare instances, another pathologic entity, such as chronic osteomyelitis, is found upon biopsy. We present here a case series in which osteomyelitis was initially misdiagnosed as OO and treated by RFA.

Materials and methods: We conducted a retrospective multicentre study involving two university hospitals with orthopaedic oncology teams and multidisciplinary sarcoma board. We extracted all patients treated by RFA with a per-procedure biopsy for an OO suspicion, based on clinical and radiological characteristics, between 2005 and 2017. We classified them into three categories, based on biopsy results confirmed osteoid osteoma (OO), osteoid osteoma mimicking lesion (OOML) and non-conclusive biopsy (NCB). We then analysed the chronic osteomyelitis cases in the OOML group. The aim was to determine their outcome and evaluate whether RFA might be curative for these patients. We also did a concise literature review on that rare presentation.

Results: A total of 81 patients treated with RFA for an OO suspicion during the selected period in both centres. Fifteen patients were excluded because of grossly missing data. Sixty-six patients were retained (71% men and 29% women). In 37.9% of patients, the diagnosis of OO was confirmed. The NCB accounted for 53%. The confirmed OOML represented 9.1% (n = 6), with three cases of osteomyelitis. All cases with OO and NCB with typical radiologic appearance had a favourable outcome. For some reasons, the three cases with osteomyelitis were not referred to our multidisciplinary team until late in the course of the disease; they were initially considered as cured by RFA, but symptoms recurred after a mean of 2.5 years. They finally healed after adequate treatment was performed, i.e. surgical debridement and adapted antibiotic therapy. Median time from initial work-up to definitive healing was 5 years!

Conclusion & perspective: Our case series and literature review confirmed that RFA is the treatment of choice for OO, even if biopsy is non conclusive, as long as history and imaging strongly supports the diagnosis. On contrary, RFA is not curative for osteomyelitis. Surgical debridement and adapted antibiotic regimen are mandatory to obtain definitive healing in chronic bone infections. When a suspected OO shows up with untypical symptoms and/or radiological features, diagnosis must be confirmed by biopsy in order to choose the adapted treatment. Similarly, in case of unexpected biopsy result, like osteomyelitis, the treatment must be in accordance with the histological findings. Our study supports the fact that bone tumours are best treated in dedicated university centres where multidisciplinary teams are available.

P1–P46: POSTERS

P1

Upper extremity injuries in winter sports: a meta-analysis of 673 270 patients *(8342)*

Aline Chauffard; Gwenael Kaminski; Dr Aurélien Traverso[1]; Jolanda Elmers; Prof. Dr Olivier Borens; Dr Frédéric Vauclair

[1] EHC - Hôpital de Morges

Introduction: Most traumatic injuries in alpine skiing and snowboarding affect the lower extremity. Snowboard gained truly in popularity in the 1990's. Alpine skiing has seen a change in equipment from the year 2000 on (appearance of carving skis). It has yet to be proven if this had an impact on upper extremity injuries. The aim of the study is to determine the epidemiology of upper extremity injuries in both alpine ski and snowboard, and confirm the impact of carving on ski injuries.

Methods: A systematic search (PRISMA) in Pubmed was conducted using the key words "skiing", "snowboard", all anatomical entities of the upper extremity and all type of injuries. Only articles focusing on alpine ski, snowboard or telemark injuries, and providing statistical data about the upper extremity were included. Prospective and retrospective studies were included,case reports were excluded. Other exclusion criteria were other kind of winter sports.

Results: The literature review represents a period from 1939 to 2017 with a total of 673 270 patients. The upper limb represents 23% of all ski injuries and 33% of all snowboard injuries. The most frequently injured segments are the shoulder (35%) and the hand (32%) for skiing, the wrist (40%) and the shoulder (31%) for snowboarding. For skiing, the main upper extremity fracture location is the proximal humerus (29%) and most dislocations are located to the glenohumeral joint (41%). For snowboarding, the distal radius is the most common site of fracture (36%) and the major part of dislocation is located at the elbow (48%). The incidence of fractures is significantly higher in snowboarding for humeral diaphysis (OR: 1.50 [1.33, 1.69]), fractures around the elbow (OR: 2.57 [1.89, 3.49]), forearm fractures (OR: 16.15 [13.48, 19.34]) and wrist fractures (OR: 5.18 [4.18, 6.42]) but it is more likely to get a proximal humerus (OR: 0.52 [0.38, 0.71]) or hand fracture (OR: 0.48 [0.28, 0.82]) while skiing. For skiing, the time trends from the year 2000's on have shown a significant increase in fractures (OR: 2.51 [1.93, 3.26]) , shoulder girdle dislocations (OR: 2.67 [1.98, 3.61]) and hand sprains (OR: 8.26 [4.68, 14.58]). Snowboard's epidemiology did not show any significant change.

Conclusion: Upper extremity injuries associated with winter sports are frequent with an incidence of 23% for alpine ski and 33% for snowboarding. Our meta-analysis confirms that carving has increased the incidence of upper extremity fractures.

P2

Too big to hurt – Deposits in calcific tendinitis are aggregates of highly crystalline needle-like structures *(8428)*

PD Dr. Karim Eid[1]; Dr. José Mateos[2]; Dr. Andres Käch; Prof. Dr. Urs Ziegler

[1] Klinik für Orthopädische Chirurgie und Traumatologie, Kantonsspital Baden; [2] Center for Microscopy and Image Analysis, University of Zurich

Introduction: Calcific tendinitis is a frequent cause of shoulder pain but is also found in 3% of non-painful shoulders. Factors associated with the onset of pain are unknown, however acute inflammation may lead to resorption of the calcification. In the current literature, calcific depositions are described as amorphous masses of hydroxyapatite.

Patients and methods: Calcium deposits from four patients with calcific tendinitis of the supraspinatus tendon were harvested and analyzed by scanning electron microscopy and energy dispersive X-ray analysis (EDX).

Results: All samples showed round- (size 1-10µm) and bulk- shaped aggregates of crystalline -needle-like structures. These needles have a size of approximately 100 nm in length and 20 nm in width. Chemical composition by EDX analysis showed that crystals were composed of mainly calcium, oxygen and phosphorus resembling the chemical composition of hydroxyapatite.

Conclusion: Deposits in tendinitis of the rotator cuff are not amorphous but composed of large aggregates of highly crystalline structures. It is conceivable that the aggregates are too big to cause an inflammatory reaction, but that particles thereof might be phagocytized and initiate inflammation leading to resorption.

P3

Surgical repair of a traumatic avulsion of the serratus anterior muscle leading to scapular dyskinesis: a case report *(8147)*

Dr. Omid Jamei-Martel; Dr Michele Palazzuolo; Dr Nicolas Gallusser; PD Dr Beat Kaspar Moor

Introduction: Scapular dyskinesis caused by traumatic detachment of the serratus anterior muscle from its insertion site on the inferior angle of the scapula is a very rare condition. Only a few case reports describe such an injury which is reported to be treated conservatively in almost all studies.

Methods: We report our unique experience with a 58-year-old policeman who was referred to our clinic four months after a direct trauma on his scapula. He presented with shoulder pain and clinically obvious medial winging. Initial management with well conducted physical therapy showed no improvement on the patient's complaint after 2 months. Electroneuromyography was normal. Radiographs and computed tomography revealed a bony flake at the inferior angle of the scapula, raising our suspicion of serratus anterior muscle avulsion which was confirmed by MRI. We attempted a surgical exploration and transosseous reinsertion of the avulsed serratus anterior muscle.

Results: Post-operative controls were done at 6 weeks, 3 months and 1 year. 3 months after surgery, the patient reported complete relief of his shoulder pain and we observed back to normal shoulder range of motion without scapular dyskinesis. Follow-up radiographs showed good positioning and consolidation of the avulsed bony fragment. At 1 year, the patient reported complete return to normal activity and quality of life with no relapse nor surgical complication. Constant Shoulder Score and Subjective Shoulder Value raised from 52 and 50% before surgery to 80 and 90% respectively at one-year postoperative.

Conclusion: Surgical repair of traumatic avulsions of the serratus anterior muscle might be a safe and efficient therapeutic option.

P4

Sling vs Brace after Surgery for Rotator Cuff Tears: A Randomized Controlled Trial. *(8373)*

Dr. Francesco Marbach[1]; Dr. Marco Odorizzi[2]; Dr. Tommaso Binda[3]; Dr. Davide Previtali[1]; Dr. Giuseppe Filardo[1]; Prof. Dr. Christian Candrian[1]

[1] EOC (Ente Ospadaliero Cantonale) - Ospedale Regionale di Lugano; [2] Ente Ospedaliero Cantonale EOC Ospedale San Giovanni; [3] Ospedale Regionale di Locarno La Carità (EOC)

Introduction. After the surgical treatment of the rotator cuff lesions, the rehabilitation protocol can includes 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 range of motion limitation.

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. Forty patients (21 brace, 19 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 5 out of 20 patients in the group assigned to the brace and in 4 out of 18 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 rotator cuff.

P5

Glenohumeral interposition of a degloving rotator cuff tear preventing anatomic shoulder reduction – a case report *(8379)*

Stephan Radzanowski; Dr. Ulf Riede; Dr. Mai Lan Dao Trong

Bürgerspital Solothurn

Introduction: Traumatic shoulder dislocation is a common pathology. In rare cases mechanical obstruction can prevent successful closed reduction. Only a few reports have described such lesions. We report a case in which a subtle radiologic sign lead to an interposed massive rotator cuff tear as cause for irrational pain and pseudoparalysis.

Methods: We report a case of a 51 year old patient with traumatic first time anterior dislocation of the right shoulder. After reduction under short general anesthesia x-rays were interpreted as normal. Because of persistent pain his GP ordered an MRI and transferred the patient to our clinic 2 weeks post trauma. He demonstrated a pseudoparalytic shoulder with a positive belly press test. On reevaluation of the initial reduction x-ray, a slight incongruency of the glenohumeral joint was seen. The MRI demonstrated a massive rotator cuff tear (SSC, SSP and ISP) with a posteriorly dislocated and interposed SSC and long biceps tendon. At that time it was impossible to reduce the shoulder arthroscopically and an open deltopectoral approach was used. A degloving lesion with glenohumeral interposition of the entire anterosuperior cuff including the biceps tendon was found. With axial traction the cuff was repaired in a double row technique using all-suture anchors and a bicepstenodesis was performed.

Results: At 6 weeks, the patient was pain free without analgesics. ROM improved continuously. At 3 months, active flexion/abduction was 70°, at 6 months 140°, at 9 months there was no difference in flexion/abduction to the contralateral side with a 10° difference in external rotation. Motor strength was M5 for all movements and Subjective Shoulder Value was 80%, Constant score 77, QuickDASH 11.4 and ASES 81.6.

Conclusion: Persistent pain after closed reduction of a shoulder dislocation should be alerting to the treating physician. Post-reduction x-rays should always be carefully examined for subtle glenohumeral joint incongruency or joint line distension. As for pseudoparalytic shoulders, the threshold for an acute MRI should be low to differentiate a possible interposing rotator cuff tear causing the subluxation from a simple hemarthosis. If the correct diagnosis is made early, proper therapy can lead to good clinical results.

P6

Africa's specific surgical hand conditions *(8130)*

Dr Cindy Bouvet

HUG

Background: Hand surgeons going on humanitarian mission to Africa need to know some specific pathologies found in theses countries. We'll describe the main conditions that are: burn sequelae, Mycobacterium ulcerans infection and snake bite.

Post-burn scar contractures: It is a major issue in Africa, due to lack of access to medical care, patients often arrive with contractures, after the acute phase. The aim of the surgery is to give FUNCTION to these hands. To do so we have to follow a proper sequence in the surgical planification: 1: Opening of the first commissure (z-plasty), 2: Syndactyly release, 3: Contracture management: long finger flexion, 4: Wrist contractures, 5: Immobilisation of the fingers with k-wire or splints.

Mycobacterium ulcerans infection: It is a common infection in various African countries. The bacteria produces a toxin: mycolactone that will destroy the soft tissue and result in an ulcer (Buruli Ulcer). According to the WHO, in 35% of cases, the upper limb is involved and mostly children are concerned. In case of early diagnosis ulcers can be treated with surgery and antibiotics. Unfortunately most of cases consult during the chronic phase and the hand surgeon will have to deal with major tissue destruction (sub-cutaneous and tendon). Surgery aims to excise all the infected tissue. Often, due to the tendon destruction, we have to consider flaps for the coverage. In addition to surgery, the antibiotic treatment is essential (combination of Rifampicin and Clarithromycin).

Snake bite: Snake bite envenoming is a potentially life-threatening condition. According to the WHO 4.5-5.4 million people get bitten by snakes annually. Of this, 1.8-2.7 million develop clinicial illness and 81'000 to 138'000 die from complications. The cytotoxin delivered during the bite destroys the soft tissue. This is now part of the neglected diseases. Functional sequelae are major, and alike the Burulli ulcer skin coverage often requires a flap.

P7

Do psychological factors impact the outcome of surgery differently in neck versus back patients? *(8545)*

PD Dr. Anne F. Mannion[1]; Francine Mariaux; Dr. Tamas F Fekete; PD Dr. Daniel Haschtmann; PD Dr. Markus Loibl; Dr. Frank Kleinstück; PD Dr. François Porchet; PD Dr. Dezsö Jeszenszky; Prof. Dr. Achim Elfering

[1] Schulthess Klinik

Introduction: Psychological factors predict treatment outcome in lumbar spine surgery patients. However, their role in predicting the outcome of cervical spine surgery is equivocal. Depression, anxiety, catastrophizing thoughts, and fear-avoidance beliefs are some of the key psychological "yellow flags". The development of a brief "yellow flag" tool allows for the efficient evaluation of these four dimensions within the routine preoperative assessment. We compared its ability to predict outcome in patients undergoing either lumbar or cervical spine surgery.

Methods: The 4-item yellow flag instrument was completed preoperatively by 2'094 patients with degenerative spinal disorders operated between May 2015 and Jan 2018 (N=1763 back pain and N=331 neck pain patients; mean age 66± 14y; 53% female). Patients also completed the Core Outcome Measures Index (COMI)-back or -neck at baseline and at 3 and 12 mo follow-up (FU). We used cross-lagged structural equation modelling (using AMOS 18.0) to test whether the cross-sectional association at baseline and the prospective risk path from yellow flag scores at baseline to COMI at 3 and 12mo FU differed for "back" and "neck" patients.

Results: Back and neck patients did not differ significantly in their baseline yellow flag scores, except for a slightly higher anxiety in the neck patients than the back patients (p=0.02). The yellow flag scores and COMI were significantly correlated at baseline, to a similar extent for both the back and neck groups (see Figure). The yellow flags at baseline predicted a significant proportion of the variance in COMI scores at 3 mo FU with a small to moderate effect size (standardised regression coefficient, β = 0.17 (back) and 0.15 (neck)). The stability between the COMI at 3 and 12 mo FU was high (β = 0.55 (back) and 0.60 (neck)). Nonetheless, the yellow flags still added significantly to the prediction of COMI at 12 mo FU (β = 0.17 (back) and 0.13 (neck)), explaining variation that was not explained by individual differences in COMI already existing at 3 mo. The prospective risk paths did not differ in strength between back and neck groups (p>0.818) and model-fit was good (RMSEA = .05).

Conclusion: The yellow flag instrument provides a simple, practicable, reliable and valid tool for assessing key psychological attributes in patients undergoing spine surgery. These factors seem be equally important determinants of the outcome of spine surgery in neck and back patients.

P8

Perthes-like Necrosis in Young Female Gymnasts – A Pursuit for the Etiology *(8544)*

Dr. Stefan Blümel[1]; Prof. Dr. Michael Leunig[1]; Dr. Hannes Manner[1]; Prof. Dr. Reinhold Ganz

[1] Schulthess Klinik Zürich

Introduction: Perthes-like femoral head necrosis in young gymnasts over 10years was reported recently,repetitive trauma as etiology mentioned but no patho-mechanical explanation offered. Studies using Laser-Doppler flowmetry showed decreased intracapital perfusion by contact between the posterolateral femoral neck and the posterior acetabular wall. We analyzed the influence of constricting hip movements on blood flow in 3 female gymnasts treated for femoral head necrosis. Our

hypothesis was that diminished perfusion is provoked by chronic impact and not by an insult of the intracapital vessels.

Methods: Athletic intensity,exercise regimen and impact were recorded. Operative reports were checked for signs of former articular trauma. Hip morphology was assessed and compared to normal standards. MRI-and CT data were used for 3D reconstruction and simulation of joint positions in which the femoral neck retinaculum gets in contact with the acetabular border.

Results: Our patients were small sized females with first diagnosis between 10-14 years. Regular training was started as early as from 4 years old and increased up to a total of 18 hours per week. The interval between first symptoms and diagnosis ranged from 3m-2y. Radiographic parameter were normal. Surgery did not demonstrate trauma related pathologies. Simulation of motion collision showed possible contact between the retinaculum area of the neck and the postero-inferior rim in hyperextension and external rotation,a position frequently executed during training and performance.

Conclusion: Femoral head necrosis in young female athletes with relative laxity of the female hip as a predisposing factor differs from the classic Perthes necrosis by age at onset and severity. Repetitive compression of the retinacular vessels in hyperextension and external rotation might be the cause. Slight subluxation of the hip may even increase the risk under repetitive exposure, a situation occurring during training and performance. Articular tamponade as well as direct trauma to the epiphysis as a cause are unlikely to produce a necrosis of this severity. Further studies,especially with visualization techniques of the patency of the retinacular vessels are needed. Awareness of coaches may lead to a less aggressive way to high performance. For the established necrosis, femoral head reduction osteotomy combined with acetabular redirection can help to postpone joint replacement,at least into the adult age.

P9

Reconstruction of the anterior acetabular wall to repair symptomatic defects due to malpositioning of the cup after total hip arthroplasty *(8227)*

Dr. Lara Pozzi; Dr. Fabian Kalberer; Prof. Dr. Christoph Meier; Dr. Peter Wahl

Kantonsspital Winterthur

Introduction: Iliopsoas impingement (IPI) causes pain and functional impairment after total hip arthroplasty (THA). It is mostly due to an anterior overhang of the cup, forming a ridge that irritates the psoas tendon. Small overhangs might be treated conservatively or with a psoas tenotomy. Larger overhangs require cup revision. We present an alternative technique.

Methods: Report of the surgical technique used to reconstruct successfully the anterior acetabular wall in a patient suffering from persistent IPI caused by malpositioning of the cup at THA. A 67 years old male patient was referred due to persistent IPI despite psoas tenotomy after primary cementless THA with a threaded cup and an anatomically shaped stem. The cup was well oriented with inclination of 46° and true anteversion of 16° but malpositioned, causing a 20x25 mm defect of the anterior acetabular wall, the thread protruding into the iliopsoas muscle. As there was no loosening of the implants and as cup revision would solve the malposition but not the bone defect, reconstruction of the anterior acetabular wall was attempted using an ipsilateral iliac crest autograft. The operation was performed through the cranial part of the Smith-Peterson approach with osteotomy of the anterior superior iliac spine, the graft being fixated with two 2.7 mm cortical screws.

Results: Pain resolved so rapidly, causing the patient not to respect the prescribed postoperative limitations. Nevertheless, the reconstruction healed well. At the latest follow-up more than one year postoperatively the patient remained asymptomatic.

Conclusion: IPI is a recognized complication after THA. It is mostly due to an anterior overhang of the cup. In the case described above, reaming had caused a large defect of the anterior acetabular wall and the protruding cup caused persistent IPI. Cup revision would have corrected the malposition, but persistence of symptoms would have been possible due to the bone defect. For this reason, reconstruction of the anterior acetabular wall was considered and proved to be successful, avoiding the morbidity revising a well-integrated, threaded cup. If not performed previously, psoas tenotomy should be performed simultaneously to avoid persistent IPI due to the added volume of the graft. The operation can be performed through an anterior approach. Placement of the screws might be hampered by the cup.

P10

Long vs short intramedullary nail for reverse pertrochanteric fracture: a biomechanical study *(8238)*

Dr Gilles Udin[1]; Noé Schmutz[2]; Dr Fabio Becce[1]; Prof. Dr Olivier Borens[1]; Dr Alexandre Terrier[2]

[1] CHUV Cente Hospitalier Universitaire Vaudois; [2] EPFL - Ecole Polytechnique fédérale de Lausanne

Introduction: Reverse pertrochanteric fractures represents a major fracture line extending from the proximal-medial to the distal-lateral intertrochanteric region (OA classification 31-A3). Treatment is generally surgical, the option of choice being a closed reduction and osteosynthesis using intramedullary nails (IMN). This pattern is mechanically different and less stable than pertrochanteric fracture and is known to yield lesser results after surgical treatment. In particular, increased rate of non-union, medial translation, or cut out of the cephalic screw have been reported. One available option to increase the stability of the construct is to use a long intermedullary nail. But the increased stability also has its drawbacks. In particular the distal locking has to be done free hand under fluoroscopic control. This implies increased operative time, local complications and irradiations. On opposite, short nails offer a simpler and shorter procedure with a targeting device for distal locking. Implant choice has to be made considering these different risks and benefits. However no clear guidelines are currently available concerning the choice of short versus long nail for reverse pertrochanteric fractures.

Methods: We conducted a biomechanical simulation using a finite element method in order to assess the relative stability of reverse pertrochanteric fractures treated with short vs long IMN. In this preliminary study, we investigated the effect of the distal extension of the fracture. The anatomy of the proximal femur was approximated based on a CT. The micromotion at the fracture site, the volume within the nail that exceeds the ultimate tensile strength and the one exceeding the fatigue limit were computed.

Results: Micromotion at the fracture site increases with the distal extension of the fracture. A long nail increases the stability, with lower micromotion than a short nails. When using a short nail, the ultimate tensile strength was reached when the distal fracture line extends further than 5cm below the lesser trochanter. On the contrary, the ultimate tensile strength was not reached until 7cm of distal extension with long nails.

Conclusion: Results based on the ultimate tensile strength show that short nail should be avoided when the distal fracture line extends further than 5cm below the lesser trochanter. Results based in the micromotion at the fracture site show a benefit of long IMN, but without a clear cutoff for clinical guidelines.

P11

Anterior extraarticular subspine Hip Impingement can be caused by femoral retrotorsion and pincer-FAI -3D CT analysis *(8343)*

Dr. Adam Boschung[1]; Dr. Till Lerch[1]; Dr. Florian Schmaranzer[1]; Dr. Inga Todorski[1]; Prof. Dr. Klaus Siebenrock[1]; Prof. Dr. Moritz Tannast[2]

[1] Inselspital Bern, Universität Bern; [2] HFR Fribourg Kantonsspital

Introduction: It is unclear if decreased femoral torsion(FT) causes anterior intra- or extra-articular femoroacetabular impingement (FAI). Therefore, we evaluated symptomatic hips with decreased FT and hips with pincer FAI, by using computed tomography (CT)–based virtual 3-dimensional (3D) impingement simulation and compared this group with patients with normal FT and with asymptomatic hips. We aimed to investigate (1)the osseous range of motion, (2)the osseous femoral and acetabular impingement zones, and (3)if hip impingement is extra- or intra-articular in symptomatic hips with FAI.

Methods: An IRB–approved, retrospective comparative analysis was performed on a total of 84 hips. Of these, 37 hips in 24 symptomatic patients with FAI had decreased FT. These hips were compared with 21 hips of 18 symptomatic patients with anterior FAI with normal FT (10-

25) and 26 asymptomatic hips with no FAI and normal FT. All patients with FAI were symptomatic and had anterior hip pain and a positive anterior impingement test. They underwent pelvic CT scans to measure FT. Decreased FT was defined as FT less than 5°. All 84 hips were evaluated with CT-based 3D models and a validated 3D range of motion and impingement simulation.

Results: Hips with FAI combined with decreased FT had a significantly (P <0.001) lower mean flexion (114° vs 125°)mand internal rotation (IR) at 90° of flexion (18° vs 32°, P <0.001) compared with the asymptomatic control group. In a subgroup analysis, we found a significantly (P <.001) lower IR in 90° of flexion in hips with FT less than 5° combined with mixed-type FAI compared with hips with FT less than 5° without a cam- or pincer-type deformity. The maximal acetabular impingement zone for hips with decreased FT was located at the 2-o'clock position and ranged from 1 to 3 o'clock. In hips with decreased FT, most of the impingement locations were intra-articular but 32% of hips had combined intra- and extra-articular FAI in internal rotation in 90° of flexion.

Conclusion: Hips with FAI and decreased FT had less flexion and internal rotation compared with the asymptomatic control group. The majority of hip impingement due to low FT was intra-articular, but one-third had combined intra- and extra-articular subspine FAI. This could be important for patients undergoing hip arthroscopy.

P12

Location of Hip impingement for Patients with Severe SCFE – 3D-CT impingement simulation study *(8458)*

Dr. Sébastien Zwingelstein[1]; Dr. Till Lerch[1]; Dr. Florian Schmaranzer[1]; Dr. Daniel Maranho[2]; Prof. Dr. Moritz Tannast[3]; Prof. Dr. Young-Jo Kim[2]; Prof. Dr. Klaus Siebenrock[1]; Dr. Eduardo Novais[2]

[1] Inselspital Bern, Universität Bern; [2] Children's Hospital Boston, Harvard Medical School; [3] HFR Fribourg Kantonsspital

Introduction: In situ pinning is the conventional treatment for a stable slipped capital femoral epiphysis (SCFE). However, with a severe stable SCFE the residual deformity may lead to femoroacetabular impingement (FAI) and articular cartilage damage. SCFE is the most common hip disorder in adolescent patients. But the exact effect and location of impingement is unknown. The purpose of this study was to evaluate 3D impingement simulation for severe SCFE patients. Questions We asked (1) what is the hip range of motion(ROM) in terms of flexion and internal rotation (2) where is the (2) acetabular and femoral impingement located in hips with severe SCFE.

Methods: A retrospective study involving 3D CT scans of 20 hips of 17 patients with severe SCFE (slip angle >60°) between 1998-2016 was performed. Preoperative CT scans performed during this time period of patients with SCFE were evaluated. Preoperative 3D models of 20 hips with severe SCFE were reconstructed. For each hip joint, a separate femoral and acetabular 3D model was reconstructed, resulting in 40 CT-based 3D models to simulate hip ROM and location of hip impingement. Three patients (15%) had bilateral SCFE. The contralateral hips of the 15 patients with unilateral SCFE were used as a control group. Mean age was 13±2 years and 67% were male patient. 86% of the patients had an unstable slip according to the Loder classification, 81% of the patients had a chronic slip. Specific software was used for semi-automatic 3D reconstruction and for 3D impingement simulation, ROM and location of femoral and acetabular impingement.

Results: (1)ROM in terms of flexion (26±32°) was significantly (p <0.001) decreased in patients with severe SCFE compared to the contralateral side (102±9°). Internal rotation in 90° of flexion (-23±15°) was significantly (p <0.001) decreased in patients with severe SCFE compared to the contralateral side (18 ± 11°). (2)Femoral Impingement in maximal flexion was located on 3 o clock in 40% of the patients with severe SCFE and did significantly differ (p <0.001) compared to the control group. In 90° of flexion and maximal internal rotation, femoral impingement was located on 3 and 5 o clock in 40% of the patients with severe SCFE and did significantly differ (p = 0.045) compared to the control group.

Conclusion: Patient-specific 3D models for patients with severe SCFE could facilitate diagnosis and surgical decision-making and planning of hip preserving surgery.

P13

Automatic Segmentation of MRI-based 3D Models of the Hip Joint for Computer-Assisted Diagnosis of Femoroacetabular Impingement *(8486)*

Dr. Dimitri Ambühl[1]; Dr. Till Lerch[1]; Dr. Florian Schmaranzer[1]; Dr. Guodong Zeng[2]; Prof. Dr. Moritz Tannast[3]; Prof. Dr. Klaus Siebenrock[1]

[1] Inselspital Bern, Universität Bern; [2] Universität Bern; [3] HFR Fribourg Kantonsspital

Introduction: Femoroacetabular Impingement (FAI) and Hip Dysplasia are complex three-dimensional hip pathologies that can cause hip pain and osteoarthritis in young and active patients of child-bearing age. Imaging is static and based on 2D pelvic radiographs or CT scans. Recently, computer-assisted CT-based diagnosis of hip dysplasia and FAI was introduced for patient-specific planning of surgical treatment. But MRI-based 3D models would offer a radiation-free alternative. We asked What is the difference between automatic MRI-based 3D models and manual CT-based 3D models?

Methods: We performed an IRB-approved comparative, retrospective study of 31 hips of 26 symptomatic patients with FAI and hip dysplasia. We compared CT- and MR-based osseous 3D models of the hip joint of the same patients. 3D-CT scans (isovoxel: 1mm3) of the entire pelvis and the distal femoral condyles were obtained. Preoperative MR of the hip were obtained including axial-oblique T1 3D-sequence (0.8mm3 isovoxel) - and two axial anisotropic (1.2 x1.2 x 1 mm) 3D-T1 sequences of the entire pelvis and of the distal femoral condyles. Automatic reconstruction of MRI-based 3D models was performed using machine-learning (deep learning). Threshold-based manual reconstruction of CT- and MR-based 3D models was performed using commercial software (AMIRA) and were compared to automatic 3D models to calculate mean surface distance and diagnostic parameters using specific software.

Results: Difference between MRI-based 3D models was below 1mm. Median difference was 0.2 ± 0.1 mm for the proximal femur and 0.2 ± 0.5 mm for the acetabulum. Dice coefficient was 97% for the acetabulum and 98% for the femur. Correlation for six diagnostic parameters was excellent and significant (r=0.99, p <0.001) between CT and MRI-based 3D models.

Conclusion: Automatic MRI-based 3D models can replace CT-based 3D models for patients of childbearing age with hip dysplasia and FAI. Based on these excellent results, we intend to change our clinical practice and we will use automatic reconstruction of MR-based 3D models for future clinical routine instead of CT-based 3D models. This allows radiation-free and patient-specific preoperative diagnosis and surgical planning.

P14

What is the economic burden of Revision TKA due to surgical errors? *(8293)*

Dr. Bernhard Christen; PD Dr. Tilman Calliess

Articon Spezialpraxis für Gelenkchirurgie

Introduction: Approximately 60% of the revision surgeries performed on total knee arthroplasties today are due to surgical errors, such as malposition of the implants or instabilities. Aim of this study was to evaluate costs of revision total knee arthroplasty (TKA).

Methods: 20 patients undergoing revision surgery of their TKA in our department due to a mechanical problem (instability or component malposition) were retrospectively reviewed. The analysis included health care costs related to

1. delayed rehabilitation or additional treatment after primary implantation (e.g. additional physiotherapy, manipulation under anesthesia etc.)
2. additional diagnostics and consultations to analyze the problem
3. the revision surgery itself with subsequent rehabilitation
4. costs related to incapacities to work for employed patients.

Cost analysis is based on the Swiss health care system.

Results: Mean costs for a surgical-error related TKA revision was 45´250 CHF for a public insured patient (range 29´300 – 98´160 CHF). The delayed rehabilitation after index surgery contributed with 1´590 CHF, additional consultations + diagnostics for painful knee arthroplasty with 2´950 CHF, respectively. 63% (in mean 28´525 CHF) of the costs were

caused by the hospital stay for revision surgery. Nine patients went to a rehab program after revision with mean costs of 9´420 CHF per patient. Three patients had an additional hospital stay before their revision surgery related to their knee problem (MUA, arthroscopy). Average costs per stay were 9´827 CHF. Three patients were still employed and unable to work due to their disease. That had a huge impact on the costs with average 47´230 CHF per affected patient (range 32´000 – 60´000 CHF). 9 patients had an additional private health care insurance. On average, their costs were 14´673 CHF higher than for public insured patients.

Conclusion: This is the first study that analyzes the specific costs of a surgical-error related revision TKA and gives an idea of the relevant factors. This analysis is of special interest to benchmark the cost-effectiveness of new technologies meant to reduce surgical errors and revisions.

P15

Ochronosis arthropathy (OcA) *(8621)*

Dr Emmelie Chaibi[1]; Dr Julien Stanovici[2]

[1] Unité pédiatrique de chirurgie orthopédique et traumatologie CHUV; [2] CHUV / University of Lausanne

Introduction: Ochronosis arthropathy (OcA) is a rare genetic disease which cause degeneration of the joint with eventual end-stage arthritis, with the knee being most commonly affected. This condition may be treated with total knee arthroplasty (TKA) at the end stage, and is often discovered only intraoperatively. The ideal choice of TKA is unknown.

Case Presentation: A 54- year old male with chronic bilateral mechanical knee pain presented after a tentative of TKA in a secondary care center. The surgeon stopped the surgery after discovering menisci, synovial and cartilage were unusually black. Some tissue samples have been performed, and were sent for histological analysis to confirm the diagnosis of ochronosis. In this context of a rare genetic condition, the patient was referred to our department as specialists in a tertiary care center. We performed a Posterior stabilized (PS) cemented custom TKA and patella resurfacing. The patient is yet followed in the outpatient clinic, with standard follow up and good clinical result. This case report shows a typical intra-articular aspect of ochronosis and could reassure a surgeon who could meet this case once, to perform a standard procedure despite this surprising discover. The review of literature concludes, there is no superiority between different type of TKA or fixation, and clinical results are similar to standard arthritis.

P16

Double level osteotomy of the knee with 3D patient-specific cutting blocks *(8251)*

Dr. Michael Grabherr; Dr. Andreas Flury; PD Dr. Näder Helmy; Dr. Alexander Antoniadis

Bürgerspital Solothurn

Introduction: In young, active patients with a malalignment of the leg axis and a monocompartmental osteoarthritis, corrective osteotomy after failure of conservative therapies is the method of choice. The aim of a corrective osteotomy is to realign the load axis of the lower limb. There are three different techniques - distal femoral osteotomy (DFO), proximal tibial osteotomy (HTO) and double level osteotomy (DLO). The main deformity of the leg axis, which can be femoral, tibial or mutual, determines the choice of the osteotomy technique. DLO is recommended if a single osteotomy results in a joint line obliquity of >4°, which is associated with an increased failure rate and makes subsequent conversion to a knee arthroplasty more difficult. DLO is a technically demanding operation. So far, navigated surgery has improved accuracy compared to conventional surgery. In order to further increase accuracy and reproducibility even in low to middle experienced hands, we have used the proven PSI technique with patient-specific cutting blocks and reduction guides. So far, corrective osteotomies around the knee with PSI have only been performed tibially or femorally. In the literature, a DLO with PSI has not been described yet.

Case report and methods: Our 39-year-old male patient suffered from a symptomatic medial knee osteoarthritis on the right with a genu varum of 18° and a leg length difference of 3.5cm. The Oxford knee score was 28 of 48 points. We performed a CT-scan of the hip, knee and ankle joint. In cooperation with the CARD team (Balgrist University Hospital) the deformity was precisely quantified and the necessary correction in the femur and tibia were simulated. We planned a residual varus correction of 1°, which is achieved with a femoral closing osteotomy of 12° and tibial opening osteotomy of 7°. In addition, a horizontal joint line as well as a correction of the leg length difference to 1cm results.

Results: The varus deformity was corrected from 18° to 2° with a very good clinical result 18 months postoperatively. The Oxford knee score improved from 28 pre- to 45 points postoperative.

Discussion: This case report showed that in patient with severe varus malalignment and medial compartment osteoarthritis a DLO with PSI normalises the alignment, joint-angels, avoids joint line obliquity and leads to a good clinical result. We believe that PSI can be used even in complex deformities to achieve a high reproducible accuracy as planned preoperatively.

P17

A novel device for full-tunnel and all-inside tibial graft fixation in anterior cruciate reconstruction. A biomechanical cadaver study. *(8440)*

Dr. Elias Ammann[1]; Elias Bachmann[2]; Dr. Andreas Hecker[1]; Prof. Jess G. Snedeker[2]; PD Dr. Sandro F. Fucentese[1]

[1] Universitätsklinik Balgrist; [2] Universitätsklinik Balgrist / Institute for Biomechanics, ETH Zurich

Background/Purpose: In anterior cruciate ligament (ACL) reconstruction a quadrupled hamstring autograft has become the most frequent graft chosen. With regards to fixation methods, the tibial side is an issue of concern since its weak fixation has been reported to be the cause of long and short term failure. A new knotless cortical suspensory device (VariLoop tibial, ZuriMED Technologies) is tested from which it is hypothesized that it shows similar biomechanical characteristics as a hybrid fixation. The new button was tested in all-inside (AI) and full-tunnel technique (FTT) configuration and compared to an established AI suspensory device as well as to hybrid and single cortical fixation in FTT.

Materials and methods: Tibial fixation of a quadrupled tendon grafts was biomechanically investigated using five different fixation techniques in a total of 30 cadaveric porcine knees. Group 1, a hybrid configuration (Endotack & Megafix screw, Karl Storz) was compared against different extracortical only fixations either in AI or FTT configuration. Group 2 (Endotack) and 3 (VariLoop tibial) were tested in FTT configuration, while group 4 (VariLoop tibial) and group 5 (Tight-Rope-RT, Arthrex) were delivered AI. Six constructs were tested for each group in a standard testing protocol (1000 cycles from 50 to 250N and pull to failure) using a material testing machine. Ability to pre-tension the graft during insertion (N), cyclic displacement (mm), stiffness (N/mm) and force at failure (N) were compared between the groups.

Results: Cyclic displacement, stiffness and force at failure were significantly better in the hybrid configuration (group 1) compared to the Endotack only (group2) ($p < 0.05$), yet no differences were measured between the hybrid and the remaining groups. Ability to pre-tension the graft was significantly higher with the ZuriMED devices in both FTT (86.8N) and AI configuration (74.2N) compared to all other groups [(Hybrid = 26.0N, Endotack = 34.4N, Tightrope = 27.3N), $p < 0.05$].

Conclusion: Tibial graft fixation with the knotless cortical suspensory device (VariLoop tibial) achieves comparable results in both FTT and AI configuration to a hybrid fixation while avoiding the need of an interference screw.

P18

Influence of the slope of the tibial cuts on the size and rotation of the tibial component in total knee replacement *(8504)*

Dr. Petros Ismailidis[1]; Dr. Valerie Kremo[2]; Prof. Dr. Annegret Mündermann[1]; Prof. Dr. Magdalena Müller-Gerbl[2]; PD Dr. Andrej Maria Nowakowski[3]

[1] University Hospital of Basel; [2] University of Basel; [3] Hospital of Uster

Introduction: Malalignment remains a common problem in total knee arthroplasty. The objective of this study was to investigate the influence of the posterior tibial slope on the anatomical tibial axis (ATA) and with it to the rotation alignment of the tibial plateau. Furthermore, this study

examined the influence of the slope of the tibial cuts on the size of the resected tibial surfaces.

Methods: CT scans of 20 cadaver knees were orientated in a standardized coordinate system. Virtual cuts of 6 mm were performed with a slope of 0°, 3.5°, 7° and 10°. The position of the centers of rotation of the medial and lateral tibia articular surfaces were used to define the rotation of the ATA in each slope. The size of the medial and lateral articular surfaces were calculated at the native tibia and compared to the cut surfaces.

Results: The differences in the rotation of the ATA between the cuts performed with different slopes were not notable (<2°). The radii of the medial and lateral articular surfaces of the cut tibiae were notably (>20%) larger than those of the native tibiae at each slope (P <0.001). The differences between the cuts performed with different slopes were not noteworthy (<5%).

Conclusion: Differences in the posterior tibial slope do not affect the rotational alignment when using the ATA to align the prosthetic tibial plateau. Although statistically significant, the change in ATA with increasing slope is negligible. The cut tibial surface is larger than the native articular surface. Although the principal of maximal coverage remains a major consideration when choosing the size of the tibial component in total knee arthroplasty, understanding the relationship between the size of the native articular surface the cut tibial surface is important to restore knee biomechanics.

P19

Dynamic intraligamentary stabilization of ACL-ruptures – a multicentre case series *(8535)*

Dr. Monika Senftl[1]; Dr. Daniel Petek; Dr. Alex Schallberger; Dr. Anna Stock; Dr. Rolf Hess; Dr. Jonathan Spycher; Dr. Matthias Jacobi; Prof. Dr. Moritz Tannast

[1] HFR – Cantonal Hospital Fribourg

Introduction: Dynamic Intraligamentary Stabilization (DIS) is a technique for preservation, anatomical repair and stabilization of the freshly injured anterior cruciate ligament (ACL). The main purpose of this study was to clarify whether DIS would lead to similar re-operation rates compared to traditional reconstruction by autograft. Other purposes were to analyse stability and clinical outcome.

Methods: Four, from the developer independent, centres enrolled patients that underwent ACL repair by DIS, according to the specific indications given by MRI imaging at a minimum follow up of 12 month. The re-operation rate was recorded as primary outcome. Secondary outcome measures were antero-posterior knee laxity (Rolimeter® based side to side difference) and Tegner, Lysholm and IKDC Scores.

Results: A total of 105 patients with a median age of 28 years were investigated with a median follow-up of 21 months. 13 patients were lost to follow up or went abroad. Of the remaining 92 patients 15 (16.3%) had insufficient stability or a re-injury and required subsequent ACL reconstruction. These patients were excluded from further analysis, leaving 77 consecutive patients for follow-up with a median age at time of surgery of 30 years. At follow up a median antero-posterior translation difference of 2 mm was found. None of the analysed patients reported a subjective insufficiency (giving way), but in 14 patients (18.2%), the delta-AP translation was more than 3 mm. We found a median Tegner Score of 5.5, a median Lysholm Score of 95.0 and a median IKDC Score of 89.4.

Conclusion: The main finding of this multicentre study is a relevant re-operation rate of 16.3% after ACL repair with DIS. Another 18.2% showed objective antero-posterior laxity during testing raising the suspicion of postoperative non-healing. Interestingly, our demographic data showed that the median age of patients with insufficient stability was 19 years, whereas the median age of stable repairs was 30 years. The failure rate of DIS in this study is higher than that reported by the developer and higher than for reconstruction with an autologous tendon graft questioning the self-healing capacity of the torn ligament. However our successfully treated patients have a good clinical outcome based on median antero-posterior knee laxity and clinical scores comparable to patients treated by autograft reconstruction.

P20

Surgical Anatomy of the Dorsomedial Cutaneous Nerve to the Great Toe and its relation with the severity of Hallux Valgus Deformity: A Cadaveric Study. *(8201)*

Dr Sérgio Soares[1]; Dr Gustavo Campos; Prof. Dr Xavier Martin Oliva[2]

[1] Hopital du Valais; [2] University of Barcelona

Introduction: Hallux Valgus Surgery requires careful dissection of the distal part of the First Metatarsal Bone. The DorsoMedial Cutaneous Nerve to the Great Toe (DMCNGT) is vulnerable during the conventional surgical approaches. The present study aims to better understand how the DMCNGT is affected by the severity of the Hallux Valgus Deformity (HVD) and to relate it to anatomical landmarks easily identifiable during corrective surgery.

Methods: The present study was conducted on thirty-five cadaveric lower extremities. We classified each specimen according to the severity of HVD, using the Hallux Valgus Angle and the First InterMetatarsal Angle. Then, we measured the distance between the DMCNGT and the middle point of the EHL tendon at the level of the First MetatarsoPhalangeal Joint (FMPJ).

Results: At the level of the FMPJ, the DMCNGT was found at an average distance of 15 mm medial to the EHL tendon. We noticed that as the HVA and the FIMA increase, the EHL-DMCNGT distance also increases, ranging from 12mm in normal feet to 19mm in severe deformed feet. High incidence of DMCNGT complications has been reported with dorsomedial approach. Our study revealed that when the FIMA and the HVA increase, the DMCNGT's course shifts medially and the EHL tendon shifts laterally. Moreover, in 80% of the feet with mild to severe deformities, the DMCNGT was located at least 14mm further from the EHL tendon. This result indicates that there is a risk of nerve damage even with the mid-medial approach. Thus, it is meaningful to know the expected nerve's course to reduce the risk of iatrogenic nerve injury.

Conclusion: We verified that the DMCNGT might change its course in the FMPJ area depending on the severity of HVD. In order to avoid damage to the DMCNGT, we were able to estimate a danger zone ranging from 12mm to 19mm medial from the center of the EHL tendon, at the MTPJ's level. Finally, the real importance of the EHL – DMCNGT distance relies in the fact that it is a simple measurement that can be done intra- operatively and takes into account the three dimensions of the deformity. We believe it can diminish surgical complications and have an impact on post-operative morbidity.

P21

Transarticular versus transosseous minor amputation levels - a large case-control study on clinical outcomes *(8244)*

Dr. Felix Waibel; Dr. Madlaina Schöni; Dr. Thomas V. Häller; Dr. Daniel Langthaler; Dr. Martin C. Berli; Dr. Thomas Böni; PD Dr. Ilker Uckay; Dr. Lukas Jud

Universitätsklinik Balgrist

Introduction: Revision amputations are frequent after fore- and midfoot (minor) amputations, especially due to new episodes or microbiological recurrences of foot osteomyelitis (FO). We investigate whether transarticular amputations (articular exarticulation; Joint-Amp) lead to different revision risks compared to transosseous amputations (Bone-Amp).

Methods: Large, single-center, case-control, register study investigating all episodes of minor for- and midfoot amputations in adult patients; using comparative statistics, log-rank tests, Kaplan-Meier curves and multivariate Cox regression analyses with outcome "revision".

Results: We followed 739 minor amputation episodes (341 Joint-Amp, 398 Bone-Amp) in 455 patients during an average of 8.6 years (range, 2-17.5 y). Overall, 164 episodes (22.2%) required revision. The surgical revision risk in the operating theatre for Joint-Amp was 21.7% (n=74) and for Bone-Amp 22.6% (n=90; Pearson-chi2-test: p=0.42). The average time delay between the index surgery and the first revision was 0.98 years for Joint-Amp; and 1.7 for Bone-Amp (Wilcoxon-ranksum-test; p=0.57). The survival analyses showed similar evolutions for both amputation levels (log-rank-test p=0.76). In the multivariate analyses adjusting for the large case-mix, the amputation level did not influence the risk for revision. On separate analyses, only the presence of neuropathy (hazard

ratio (HR) 3.2, 95% confidence interval (CI) 1.4-7.8) was formally associated with revision for Bone-AMP. For Joint-AMP, the associated variable was chronic renal insufficiency (HR 2.0, 95%CI 1.1-4.0), but not the amputation level.

Conclusion: In patients undergoing forefoot amputations, the Joint-Amp and Bone-Amp amputation levels yield the same revision risk of 22%, at similar time periods, during a mean follow-up of nine years, respectively.

P22

Posterior to Anterior Malleolar Extended Lateral Approach to the Ankle (PAMELA): Early Results of a Novel Approach *(8281)*

Dr Anne Kummer; Prof. Dr Xavier Crevoisier

CHUV

Introduction: In a previous cadaveric study, we described this novel approach to address complex ankle fractures. It was demonstrated to provide optimal exposure of the posterior and lateral malleoli, and of the anterolateral portion of the ankle through a single incision. The aim of the present pilot study is to report the clinical application and outcome of this novel approach.

Methods: Between March 2018 and December 2019, all patients presenting with a complex ankle fracture were assessed by conventional x-rays and a CT-scan. Indication to use the PAMELA was determined by the fracture pattern, according to our previous guidelines, and validated by a senior surgeon. The approach was performed according to the steps previously described in the cadaveric study. Intraoperative evaluation included the quality of exposure, the ease of performing the fracture reduction and fixation, and any difficulty or complication encountered. The postoperative course was assessed for wound healing, quality of reduction on standard x-rays, and the occurrence of any complication.

Results: The PAMELA was performed in 17 patients, 4 men and 13 female, aged between 22 and 88 years old (mean 49) and followed up for 6 to 76 weeks. The most common combination of fractures leading to this approach was a comminuted fracture of the lateral malleolus associated with a displaced fracture of the posterior malleolus (8/17 cases). In 3 cases, the PAMELA served to correct a previous operative malreduction of the fibula. We encountered no complication during the procedure, quality of exposure and access for osteosynthesis were optimal in all cases. Postoperative x-rays showed anatomical reduction in all cases. Complications included: one wound dehiscence over 2 cm requiring an operative revision; one marginal flap necrosis, healed after local treatment; and one sural nerve traction injury with paresthesia, partially resolved at the last clinical control.

Conclusions: The main potential concern regarding this novel approach was the healing of the flap. Our results are in line with early results and wound healing complications reported following surgical treatment of ankle fractures [1]. This preliminary study confirms the safe in vivo feasibility of the PAMELA and opens a new perspective in the optimal management of complex fractures of the ankle. A larger prospective clinical study is ongoing in our institution.

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P23

Morton's Neuroma correlates with a radiologically increased interphalangeal divergence – a matched case-control study *(8310)*

Dr. Martin Zaleski[1]; Dr. Sandro Hodel; Dr. Timo Tondelli; Dr. Dominic Rigling; Dr. Stephan Wirth

[1] Universitätsspital Balgrist

Introduction: Several studies unsuccessfully attempted to find diagnostic signs in conventional X-rays for Morton's Neuroma. Clinical observations showed an increased interdigital divergence in some patients. The aim of the study was to find objective radiological signs, which could be used as an additional diagnostic tool for Morton's Neuroma in conventional dorso-plantar X-rays of the foot.

Methods: A total of 98 patients were included, of which 49 patients had a symptomatic Morton's Neuroma in the metatarsal spaces 2/3 or 3/4. Every patient with Morton's Neuroma was matched by gender, age and the side of the foot with an asymptomatic control. Patients and controls with prior forefoot operation, forefoot trauma, diabetes mellitus and rheumatic diseases were excluded. The diagnosis was made by clinical examination and magnetic resonance imaging. It was confirmed intraoperatively by a positive histopathology for all cases. The angles between the metatarsalia 1-5, 2-3, 2-4, 2-5, 3-4 and the proximal phalanges 2-3 and 3-4 were measured. The same measuring procedure was carried out in the control group. Radiographic measurements across groups were compared by signed-rank tests. Diagnostic performance of the angles was compared by Area under curve (AUC), sensitivity and specificity.

Results: There was a significantly enlarged angle of 2.7° (median; $p < 0.001$) between the proximal phalanges affected by Morton's Neuroma compared to the controls. The corresponding diagnostic characteristics of the angle were an AUC 0.75 ($p < 0.001$), a sensitivity of 73% and specificity of 76% with a cut-off value of 3.9°. Based on our data, a divergence of more than 3.9° (cut-off-value) of the suspected proximal phalanges suggests the presence of a Morton's Neuroma in the corresponding intermetatarsal space. Additionaly we found a 1° (median; $p < 0.048$) enlarged angle between the metatarsalia 3-4 affected by Morton's Neuroma compared to the asymptomatic controls with an AUC 0.64 ($p < 0.031$), a sensitivity of 71% and specificity of 43%. We did not find a significant difference between the other angles or a correlation between the angles and the size of the Morton's Neuroma in the magnetic resonance imaging.

Conclusion: This matched case-control study finds an enlarged angle between the proximal phalanges in conventional dorso-plantar X-rays of feet affected by Morton's Neuroma. These findings provide additional information in the diagnosis of Morton's Neuroma.

P24

Tibio-talar relationship in the sagittal plane after mobile- versus fixed-bearing total ankle replacement (TAR): a radiological study *(8423)*

Pauline Kapustin[1]; Dr Katarina Stanekova[2]; PD Dr Mathieu Assal[3]; Prof. Dr Xavier Crevoisier[2]

[1] UNIL / CHUV; [2] CHUV University Hospitals and University of Lausanne (UNIL); [3] Centre Assal de Médecine et de Chirurgie du Pied

Introduction: The advantages of using either a fixed- or mobile-bearing system for total ankle replacement (TAR) are still debated. Furthermore, few data exist to compare the influence of either system on the tibio-talar relationship. The aim of the present study is to determine the differences between a fixed- and a mobile-bearing system from the same manufacturer in terms of influence on the articular morphology in the sagittal plane. We hypothesized that TAR modifies the position of the talus relative to the tibia, that this modification is higher for the fixed-bearing system, and that a correlation exists between the tibial slope and the talar position.

Methods: We conducted a retrospective radiological study on 54 patients operated on by a single team for a either a mobile-bearing (Salto®) or a fixed-bearing (Talaris®) TAR. The anatomical tibial axis, the tibial slope, the center of rotation (COR) of the talus were determined on weight-bearing lateral x-rays of the ankle prior to surgery, at 3 months, and 2 years post TAR. Intra-observer reliability of the measurements was verified. We applied a linear regression to determine the influence of the tibial slope on the talar position. We used a paired t-test to determine the modification of the values in time and a t-test for independent samples to compare the two groups.

Results: We included 26 Talaris- and 28 Salto-patients. M/F and age repartition was similar in both groups. In relation to the tibial axis, the COR talus moved anteriorly by 1.8±3.2 mm ($p=0.008$) in the Talaris group and remained unchanged in the Salto group. There was a significant correlation between the tibial slope and the position of the COR talus relative to the tibial axis in the Talaris group at 3 Mo ($p=0.008$) and 2 Y ($p=0.006$). In the Salto group this correlation was significant a 3 Mo ($p=0.009$) but disappeared at 2 Y.

Conclusion: The Talaris system anteriorizes the COR talus in relation to the tibia but this is not the case after implantation of the mobile-bearing Salto prosthesis. The tibial slope influences the position of the COR talus in the Talaris system. This is also true at 3 Mo in the Salto group but this influence disappears at 2 Y, thus showing that a mobile-bearing TAR only temporarily modifies the articular geometry in the sagittal plane and that

the talus, then, returns to its preoperative position. To establish the correlation between these results and the functional outcome is the object of a future study

P25

A subpopulation of human skeletal muscle stem cells with high regenerative capabilities *(8451)*

Benoit Borner; Ysaline Grand; Prof. Dr Didier Hannouche; Dr Thomas Laumonier

University Hospital and Faculty of Medicine

Introduction: Severe skeletal muscle injuries typically result in the formation of fibrotic tissue that impairs muscle function. Cell therapy is considered as a promising approach for improving muscle regeneration. We recently demonstrated that human myogenic reserve cells (MuRC) are quiescent myogenic stem cells with properties required for their use in cell therapy i.e. they survive, they form new myofibers and they generate new Pax7+ cells in vivo. Moreover, as compared to other muscle stem cells, MuRC hold the advantage to be generated in vitro in a number compatible with possible therapeutic applications. In this study, we characterized the cellular and molecular heterogeneity of human MuRC and we also evaluated their metabolism.

Methods: Procedures undertaken with human tissue were done according to national and international guidelines. Freshly isolated human MuRC were analyzed by flow cytometry, western blot and qRT-PCR for various myogenic transcription factors. Their mitochondrial respiration and glycolytic function were also evaluated using Seahorse technology.

Results: Human MuRC basal respiration as well as glycolysis and maximal glycolytic capacity were significantly reduced as compared to human myoblasts. By flow cytometry, using an antibody recognizing Pax3 and Pax7, we distinguished two human MuRC populations: a Pax3/7Hi and a Pax3/7Lo. The proportion of Pax3/7Hi increased with time in differentiation with 22.5±6%, 39.6±8% and 48±6.8% of the RC population respectively after 48h, 96h and 144h in differentiation condition.

Conclusion: These findings demonstrate that human MuRC contain a subpopulation that co-express higher level of Pax3 and of Pax7, which proportion increases with time in DM. We are currently performing gene analysis on these two MuRC populations after cell sorting through Pax7/Pax3 selection. The Pax3/7Hi MuRC subpopulation may constitute an appropriate source of muscle stem cells more directly pertinent to clinical applications.

P26

Post traumatic pseudoarthrosis of a clavicle fracture in an 11 year old girl: a case report and analysis *(8206)*

Dr. Marco Odorizzi; Maurice Fitzgerald[1]; Dr Jorge Gabriel Gonzalez[2]; Dr Dario Giunchi[3]; Dr Flurim Hamitaga[2]; Dr. Vincenzo de Rosa[4]

[1] IPSI Bellinzona; [2] Ente Ospedaliero Cantonale; [3] Ospedale Regionale di Lugano - Sede Civico, Lugano Switzerland.; [4] Ospedale San Giovanni Bellinzona

Introduction and objective: Clavicular fractures are some of the most common bone injuries in the paediatric population, yet the rates of nonunion is very low under 18 years. To the best of our knowledge, posttraumatic nonunion of the clavicle in a paediatric population is rarely reported.

Materials and methods: We report the case of a 11 year old girl who presented with a non dislocated fracture of the midshaft to proximal third of the right clavicle. Initial conservative treatment by sling immobilisation demonstrated radiologically confirmed healing at 3 months. However, at 1 year follow up she presented with painful non-union. Diagnostic MRI and CT exams confirmed a pseudoarthrosis, requiring elective open reduction and internal fixation with the aid of an ipsilateral iliac crest bone graft.

Results: Following a normal post operative course, clinical and radiological follow up showed complete isometric anatomical healing at 1 year from the operation with a full recovery range of motion of the shoulder.

Conclusions: Paediatric post-traumatica clavicular non union is rare but remains a potential complication and therefore requires physician awareness and early identification. Though the case population is small and consensus is not unanimous as yet, it appears that clinical follow up with the need of serial X-ray and radiation exposure is a safe management option. There is a possibility that post-traumatic pseudoarthrosis of the clavicle may have a congenital component, in that it is a population under-diagnosed until the time of presentation. However the discrimination between a "true" traumatic non-union and a previously undiagnosed "congenital" non-union may have little clinical impact on diagnosis, follow-up and treatment strategies. Additionally as in our case, when operative intervention is necessary, plate fixation and autologous graft usage proves an excellent therapeutic option.

P27

Treatment of paediatric unstable displaced distal radius fractures using Kapandji technique: a case series *(8228)*

Dr Silvia Valisena; Dr Jorge Gabriel Gonzalez; Dr Natalia Maria Voumard; Dr Flurim Hamitaga; Dr Mario Mendoza Sagaon; Dr Vincenzo De Rosa

Introduction: The technique of intra-focal pinning described by Kapandji is seldom used in paediatric patients. We present our series of paediatric patients treated with Kapandji technique for unstable displaced distal radius fractures.

Methods: We retrospectively reviewed medical records and radiographs of a consecutive series of 56 paediatric patients who underwent closed reduction and fixation with Kapandji technique for unstable displaced metaphyseal and Salter Harris 2 distal radius fractures, from 2008 to March 2018. One or two percutaneous K-wires were inserted intrafocally without crossing the physis to lever out, reduce and stabilize the distal fragment. The arm was immobilized with an above-elbow cast, and radiographic controls were scheduled at 1, 4, 8 weeks, at least.

Results: The mean age at the time of the trauma was 10.5 years. The K-wires were removed at a mean of 6.4 post-operative weeks. An above-elbow cast was used for the first 4 weeks, afterwards a below-elbow cast for 2 weeks and a short-arm brace until the full recovery of motion. The mean follow-up was 18 months (range 1.5–108 months). No pin-related complications were found. All fractures showed good healing, and the full function of the wrist was achieved in every case.

Conclusion: Kapandji pinning is a reliable technique in paediatric patients with unstable displaced distal radius fractures. It shows a lower complication rate compared to other techniques. For these reasons, we suggest implementing its use in clinical practice.

P28

Corticosteroid-induced osteonecrosis of the humeral head in acute lymphocytic leukemia treated with biphosphonates: a case report of a 11-year-old patient *(8334)*

Dr. Julia Müller[1]; Dr. Daniel Studer; PD Dr. Andreas Marc Müller; Prof. Dr. Carol-Claudius Hasler; Dr. Nicole Vogel; Dr. David Haeni

[1] Universitäts-Kinderspital beider Basel (UKBB)

Introduction: Acute lymphocytic leukemia (ALL) is the most common type of cancer in children. The main treatment typically includes long-term chemotherapy, which can cause side effects, such as osteonecrosis (ON) . Evidence-based therapeutic guidelines for corticosteroid-induced humeral head ON in children are not available and the range of treatment options include several operative and non-operative procedures.

Methods: We report on a 11-year-old female patient with pre-B-cell ALL who underwent chemotherapeutic treatment. 6 months after the start of therapy, bilateral ON of the humeral head was diagnosed. A conservative treatment with bisphosphonates was performed.

Results: A 11-year-old female was diagnosed with a pre-B-cell-ALL. A chemotherapy according the AIEOP-BFM ALL, SR, 2009 was initiated. After 6 months she developed bilateral ON of the humeral head induced by long-term chemotherapy. Diagnostic imaging of the left shoulder showed a necrosis of the humeral head stage III (Cruess classification). The initial treatment was non-operative including pain management and intensive physiotherapy. Regular follow-up revealed the progression of the necrosis with complete collapse of the humeral head and partially preserved cartilage (Grade IV, Cruess Classification). During the consolidation phase, the patient underwent intravenous infusions with bisphosphonates every 6 months. Clinically both, the range of motion and the pain improved, with VAS 3/10 and a Constant Score of 63/100. Further imaging showed an almost complete remodeling of the sphericity of the

humeral head with improvement of the subchondral bone density without cartilage detachment.

Conclusion: ALL is the most common type of cancer in children. Sometimes side effects include corticosteroid-induced avascular ON. A possible non-operative treatment is intravenous infusions with bisphosphonates which inhibit osteoclastic bone reabsorption and appear to have beneficial effect on osteoblasts. In a murine model of glucocorticoid-induced osteoporosis, bisphosphonates prevented osteocyte and osteoblast apoptosis. Treatment with intravenous bisphosphonates however should be considered as a treatment option for immunosuppressed patients and could possibly help to avoid a surgical approach, such as arthroscopic core decompression. To our knowledge, there are no reports of successful non-operative management of corticosteroid induced humeral head ON in children.

P29

Rare secondary, foreign body induced knee arthrofibrosis in a pediatric patient. *(8338)*

Dr. Franziska Kocher[1]; Dr. Edouard Stauffer[2]; Dr. Ines Raabe[1]; Prof. Dr. Moritz Tannast[1]; Dr. Daniel Petek[1]

[1] Department of Orthopedic Surgery, Cantonal Hospital HFR-Fribourg, Switzerland; [2] Promed Medical Laboratory, Marly, Switzerland

Introduction: Arthrofibrosis is a recognized complication that may affect the knee joint after trauma or surgery. It is generally described as a painful loss of motion due to an excessive fibrotic response during a healing process. Primary arthrofibrosis is related to an excessive global fibrotic healing response of still poorly understood etiology, while in secondary arthrofibrosis, the loss of articular motion is caused by a local fibrotic healing disturbance.

Material and methods: Report of a clinical case focusing on the clinical, radiologic, histopathologic characteristics and a review of the literature.

Results: A 14-years old boy with increasing anterior knee pain especially during sports activities associated with progressive loss of motion consulted the outpatient clinic. The past medical history revealed an anterior tibial spine avulsion type Meyers-McKeever III that had required an open reduction and internal fixation two years ago followed by hardware removal one year later. Physical examination revealed a swelling of the soft tissues around the patellar ligament, a light effusion without ligamentary laxity and a knee range of motion (ROM) of 95-10-0. The patellofemoral joint was entrapped with no medial or lateral glide. The Knee Society Score (KSS) was of 73. Complementary investigations (standard x-rays, MRI) reported an intraarticular fibrous tissue localized behind the patellar ligament and detected a surgical thread running from the Hoffa fat pad through the patellar ligament to the antero-medial soft tissue. The foreign body (Ti-Cron, 6cm long) has been fully removed from its intraarticular location and an arthroscopic procedure was performed to debride the anterior scar tissue and to allow a proper arthrolysis. Intraoperative, the ROM was 125 -0 -0. Intensive physiotherapy and continuous passive motion stared immediately post-operatively. 6 months after surgery, the patient regained an almost pain free function with a ROM of 120-5-0. The KSS improved to 90.

Conclusion: An intraarticular foreign body may induce a chronic inflammatory response that may lead to a secondary arthrofibrosis. Complete surgical removal combined with an arthroscopic arthrolysis is mandatory to allow the recovery of knee function. Care shall be taken while removing intraarticular material.

P30

Rare Lisfranc injury in a pediatric patient *(8407)*

Dr. Franziska Kocher[1]; Dr. Geoffroy Barbier[1]; Dr. Michael Stalder[2]; Dr. Ines Raabe[1]; Prof. Dr. Moritz Tannast[1]; Dr. Daniel Petek[1]

[1] Department of Orthopedic Surgery, Cantonal Hospital HFR-Fribourg, Switzerland; [2] Department of Orthopedic Surgery, Hospital Interlaken, Switzerland

Introduction: Lisfranc injuries are rare and uncommon foot lesions in children and adolescents that often go undiagnosed. The main mechanism of injury is first a forced plantar flexion and abduction of the foot then, and less common a direct blunt trauma. Regularly, standard loaded radiographs are often not sufficient enough for the diagnosis so that a complementary CT-scan is recommended to define the extent and displacement of such lesions. Depending on the location and dislocation, a non-operative or surgical treatment is indicated.

Material and methods: Report of a clinical case focusing on clinical and radiologic characteristics as well as a review of the literature.

Results: An 8-year-old girl presented in our emergency department after a horse riding accident with severe pain in her left ankle and foot. Physical examination revealed a plantar hematoma and pain along the tarsometatarsal (TMT) joints. Radiological studies showed a medial cuneiform fracture with fragment dislocation and a displacement of the 1st metatarsal medially. Further minor fractures at the bases of the 2nd to 4th metatarsals associated with a non-displaced fracture of the navicular and distal fibula type Weber A were noted. Due to the dislocation of the 1st TMT joint a surgical treatment was favored with dorsal midfoot approach including an open reduction of the TMT1 joint and reconstruction of the medial cuneiform with cancellous bone autograft and temporary arthrodesis of the 1st TMT by dorsal plating. Postoperative treatment consisted of an immobilization in a short leg cast for 2 months without weight bearing. Hardware removal was performed after 3 months with documented fracture consolidation. Intraoperative exam after removal showed equal stability of TMT joints. Progressive weight bearing with free foot motion was then started. There was no clinical instability of the TMT joints at six months.

Conclusion: Lisfranc injuries are rare in pediatrics patients but its consequences may be disastrous if missed and not well addressed. Due to the paucity of the literature about this specific pediatric lesion, a standard consensus may not be proposed. The various reports published to date outline a treatment rationale that mimics adult fixation strategies. We recommend open reduction and internal fixation for any instable, dislocated Lisfranc injury to allow proper mid-/ forefoot alignment also in pediatric patients.

P31

Congenital focal fibrocartilaginous dysplasia (FFCD) of the distal femur – a rare differential diagnosis for progressive limb malalignment in toddlers *(8540)*

Dr. Győzö Lehoczky[1]; Prof. Dr. Fritz Hefti[2]; PD Dr. Andreas H. Krieg[2]

[1] Universitätsspital Basel (USB); [2] Universitäts-Kinderspital beider Basel (UKBB)

Introduction: The tethering of the physis from a fibrotic band, originating from the distal femur diaphysis to the femoral condyle results in a progressive knee malalignment in toddlers. We describe our experience with follow-up up to 15 years by treating patients with this rare condition.

Methods: Children were assessed with clinical and radiological (X-ray, Magnetic Resonance Imaging) findings. Diagnosis occured by visualizing the bone deformation caused by the accessory ligament on X-ray and on the strand itself on MRI, and eventually the ligament was also palpable. Important was to differentiate the condition from non ossifying fibroma or fibrous dysplasia, and in the case of one patient with Café-au-lait-naevi also from McCune Albright Syndrome. After an observation period of 9-15 months, by strongly progressive malalignment, operative treatment was performed.

Results: We treated three patients in the median age of 2.5 years old (range 2-2.5 years) at the University Children's Hospital of Basel, from 2004 to 2019. In 2 cases varus and in 1 case valgus deformation of the distal femur of a mean 32.7° (range 31°-34.8°) was measured at the time of operation. Leg-length discrepancy up to 3 cm was found. Resection of the fibrotic band and, in two patients, additional dome correction osteotomy was performed. Children were mobilized after 6 weeks of casting, with fast recovery afterwards and no need for permanent physiotherapeutic treatment. No second surgery was needed and fully functional and alignment recuperation during the follow-up until 15 years after the operation was observed, as well as leg-length discrepancy was carried back to normal value.

Conclusion: Toddlers with congenital focal fibrocartilaginous dysplasia of the proximal femur, even with strong deformity and clinically relevant leg-length discrepancy can be treated effectively with a one-stage resection of the disorder and correction dome osteotomy.

P32

Symptomatic hypercalcaemia after application of local antibiotics with calcium sulphate as carrier material might have a multifactorial etiology: report of two cases and estimation of the incidence *(8390)*

Dr. Faustine Vallon[1]; Prof. Dr. Christoph Meier[1]; Prof. Dr. Emanuel Gautier[2]; Dr. Peter Wahl[1]

[1] KSW-Kantonsspital Winterthur; [2] HFR - hôpital fribourgeois

Local application of antibiotics is used commonly as an adjunct in the treatment of bone and joint infections. Calcium-containing carrier materials (CCCM) have the advantage of being compatible with many antibiotics and no secondary removal is required, because CCCM dissolve within weeks to months, without residues. However, the delivery of large quantities of calcium might be of concern. Some cases of hypercalcaemia in patients treated with CCCM have been reported in the literature. Based on a large case series, the incidence of symptomatic hypercalcaemia in patients with CCCM is estimated. Furthermore, risk factors of the affected cases are analyzed.

Retrospective analysis of a consecutive case series of patients treated with antibotic-loaded CCCM for various orthopaedic infections between 10/2006 and 02/2019. Estimation of the incidence of symptomatic hypercalcaemia and a risk factor analysis was performed.

In total, 215 CCCM applications were analyzed. Two patients (0.9%) developed symptomatic hypercalcaemia. In one case, hypercalcaemia occured 14 days after the second CCCM application with vancomycin during a two-stage septic hip revision. The analysis revealed renal insufficiency and excessive calcium intake due to abusive milk consumption (>3 l/day) as risk factors. In the other case, hypercalcaemia became symptomatic six days after debridement, component retention and application of vancomycin-loaded CCCM in a septic revision hip arthroplasty. The similar symptoms of daptomycin toxicity might have obscured the correct diagnosis of symtomatic hypercalcaemia. In addition, this patient also had an impaired renal function and on a long-term treatment with Vitamin D. In both cases, prolonged immobilization was present as a risk factor. Successful correction of the hypercalcaemia was achieved with forced diuresis, subcutaneous calcitonin and intravenous zolendronate application, without further complications.

Implantation of a dissolving antibiotic carrier material containing large quantities of calcium might induce symptomatic hypercalcaemia, which is a potentially life-threatening complication. The observed incidence of symptomatic hypercalcaemia was <1% in this series. However, in some patients compensatory mechanisms might be overwhelmed in the presence of other risk factors. Thus, postoperative monitoring of calcaemia as well as elimination of risk factors should be considered for all patients treated with dissolving CCCM.

P33

A coxoperitoneal shunt as salvage procedure for recurrent giant seroma of the hip after periprosthetic joint infection *(8258)*

Dr. Aude Lehnen; Dr. Roland Wyss; Dr. Björn Walter; Prof. Dr. Christoph Meier; Dr. Fabian Kalberer; Prof. Dr. Stefan Breitenstein; Dr. Peter Wahl

Kantonsspital Winterthur (KSW)

Introduction: Resection arthroplasty (RA) of the hip usually is considered as an acceptable salvage procedure for failed periprosthetic joint infection (PJI). Recent literature however shows mostly poor patient-related outcomes. We report a case of successful treatment of a recurrent giant seroma of the hip complicating RA, and which persisted despite joint reconstruction, that could be treated successfully by internal drainage through a coxo-peritoneal shunt.

Methods: Report of a single clinical case.

Results: A 44 years old obese (BMI 33 kg/m2) male patient, known for alcohol, benzodiazepine and i.v.-drug abuse, had a total hip arthroplasty (THA) performed 6 years earlier for avascular necrosis, which developed an S. epidermidis infection diagnosed after 5 years. After failure of 2 attempts of two-stage revision, RA had been performed. The hip remained painful, and a giant seroma developed, impairing sitting in a wheelchair. After drug and alcohol abstinence for over a year, reconstruction was attempted. Despite reestablishment of hip length, seroma formation persisted, with critical distension of the skin. All conservative treatment attempts failed, including weekly aspirations, as did obliteration of the cavity with a latissimus dorsi flap. The seroma formation could finally be controlled with an internal drainage through laparoscopically-assisted placement of a shunt connecting the hip with the peritoneal cavity. Now nearly 2 years later, there are no signs of infection recurrence, and the soft tissues healed well. Full weight bearing is possible on the affected leg, even if abductor insufficiency is present.

Conclusion: Resection arthroplasty of the hip often offers unsatisfying results, with pain and severely impaired function. Every effort should be made to reconstruct the joint. In our case, despite reestablishment of hip length, giant seroma recurred in the established soft tissue defect. After failure of all other attempts, the hip was drained successfully into the peritoneal cavity by a shunt, placed with laparoscopic assistance. This avoids the risk of superinfection associated with external drainage. The peritoneal cavity can be used for dialysis, as it is capable of absorbing large quantities of fluids. It might be expected that even fluids infected by microorganisms with low-virulence could be handled successfully that way.

P34

A recurrent perianal fistula might be an unusual sinus tract of a periprosthetic hip infection – a case report *(8399)*

Dr. Katharina Reinisch; Prof. Dr. Christoph Meier; Dr. Peter Wahl

Kantonsspital Winterthur

Introduction: We present a case in whom a recurrent perianal fistula was due to a periprosthetic joint infection (PJI) of the hip. As a presentation with only such an atypically located fistula is very uncommon, the features of this case are presented.

Methods: Presentation of a clinical case.

Results: A 89 years old male patient had been referred because of a florid fistula complex running from the gluteal skin fold proximally between the ischium and the rectum. A fistulectomy was performed. No internal fistula opening could be identified. There was no definite wound healing over the next months, despite repeated fistulectomy and negative pressure wound therapy. Repeated MRI identified a persistent fistula, extending to the lamina quadrilateralis of the acetabulum, where total hip arthroplasty (THA) had been performed 15 years earlier. This hip always had been painful and stiff since the operation, but initially the treating orthopaedic surgeon, and later the patient himself, had refused further investigations. Joint aspiration proved PJI with a mixed flora of various staphylococci, Gram negative bacilli and multiple anaerobes. Confronted with a chronic PJI with osteomyelitis of the acetabulum as well as of the proximal femur, and with a fistula not entirely accessible to debridement, a two-stage exchange with a spacer and a long interval was performed through a transfemoral approach. Antibiotic treatment combined vancomycin, ceftriaxone and metronidazole systemically with vancomycin and aztreonam mixed into the bone cement used to form the spacer. The fistula healed quickly. Local evolution permitted reimplantation as planned. The antibiotic treatment had to be stopped earlier as planned due to diarrhoea. Now 4 months post-reimplantation, recovery goes on well.

Conclusion: PJI of the hip presenting solely with a perianal fistula is very uncommon. MRI identified the the connection. The treatment required two-stage exchange, which rapidly closed the fistula. Considering the bacterial flora identified, a postoperative PJI with coagulase-negative staphylococci probably was causative, the other bacteria identified being probably retrograde contaminants. Arthroplasties should always be considered as being potentially involved in fistulating disease or abscess formation in the vicinity, not only because of potential secondary contamination, but also as primary cause.

P35

"Pyoderma Gangraenosum in a 3 Degree Open Fracture after a Forest Accident- When You Can't See the Wood for the Trees" *(8424)*

Annika Hartmann; Dr. Sonja Bertschy; Dr. Frank Beeres; Prof. Dr. Matthias Knobe; Prof. Dr. Reto Babst; PD Dr. Björn-Christian Link

Kantonsspital Luzern

Introduction: Posttraumatic pyoderma gangraenosum (PG) is a rare chronic neutrophile inflammatory dermatitis. The incidence is unknown, and so is the etiology. There are no associations with systemic diseases.

Methods: We describe a case of a 55 years old forest worker, who was admitted to our department with a Gustillo III dislocation fracture of his left ankle joint. After initial external fixation, round necrotic lesion with hyperemic border walls appeared on his entire lower leg independently of the wounds. Recurrent debridments worsened the soft tissue situation instead of improving it. Histology proved PG. An immunoglobulin- and corticosteroid-therapy was installed, which diminished the inflammatory reaction, and finally granulation of soft tissue began.

Results: Early histological workup is the key to correct diagnosis. Immunoglobulins and corticosteroids are indispensable treatment of PG.

Discussion: Posttraumatic appearance of a PG is possible, even in otherwise healthy patients not suffering from systemic diseases. Early diagnosis and initiation of treatment is essential in order to minimize the extent of soft tissue damage. In contrast, a surgical approach aggravates the course of the disease.

In conclusion, posttraumatic PG is a rare diagnosis. Nevertheless it needs to be on the list of differential diagnosis if uncommon soft tissue reactions appear.

P36

Periprosthetic joint infection with secondary septicaemia or acute haematogenous infection: The decisive role of histopathology *(8465)*

Alina Vogl[1]; Dr. Corina Dommann-Scherrer[1]; Prof. Dr. Christoph Meier; Dr. Peter Wahl

[1] Kantonsspital Winterthur (KSW)

Introduction: Periprosthetic joint infection (PJI) affects approximately 1% of all total hip arthroplasties (THA) and 2% of all total knee replacements. Surgical site contamination is the most frequent cause of PJI. However, secondary haematogenous infection is a known alternative cause. Discrimination between PJI complicated by secondary septicaemia and acute haematogenous PJI may be difficult, in particular early after THA or if other causes for pain unrelated to PJI are present. We present a case of PJI in which histopathologic workup was decisive to determine the chronology of infection.

Methods: Case report. A 66 years old female with a history of chronic morphine abuse and chronic inflammatory bowel disease presented with septicaemia and right hip pain. THA had been performed 15 years earlier and the patient had complained of chronic hip pain ever since. After blood sampling and joint fluid aspiration, parenteral antbiotic treatment with amoxicillin/clavulanate was initiated. In the blood cultures, Gram positive cocci were identified within hours and confirmed in the joint fluid aspirate on the following day. Preliminary results however pointed towards Streptococci in the bloodstream and Staphylococci in the joint. The analysis of the aspirate demonstrated a cell count of 59'851 leucocytes/µl with 91% polymorph nuclear cells (PMN). Revision with debridement, replacements of modular components and local application of vancomycin-loaded CaSO4 beads was performed. During surgery, severe fibrosis of the capsule with joint obliteration was noted.

Results: Histopathology of capsule biopsies showed a massive perivascular PMN infiltration with small intracapsular pyemas. However, inflammation of the synovial pseudomembrane and proliferation of macrophages with phagocytosis of microparticles were rather discrete. Thus, acute haematogenous spreading was determined as the originating cause for PJI. Streptococcus mitis/oralis was identified by microbiological culturing. Further treatment included a 12-week course of antibiotics according to sensitivity testing.

Conclusions: Histopathology was decisive to discriminate between PJI complicated by secondary septicaemia and acute haematogenous PJI in the presented case. It also provide rapidly this answer. These findings had a direct impact on the treatment strategy. Chronic PJI might have required prosthesis exchange whereas in PJI due to haematogenous spreading, prosthesis retention was feasible.

P37

Septic shock in prepatellar bursitis in a healthy 24 year-old *(8500)*

Dr. Leonie Hellermann; Dr. Carol Strahm; Dr. Diana Rudin; Dr. Henrik Behrend; Dr. Benjamin Martens

Introduction: With an annual incidence of about 10 per 100,000 population, prepatellar bursitis is a familiar sight to general practitioners and orthopaedic specialists alike. The most challenging aspect of treatment is to differentiate at an early stage between septic and non-septic bursal inflammation. We present a well documented case of a young immunocompetent male with fulminant septic shock caused by Streptococcus pyogenes, which caused maximum surgical effort to safe his life.

Methods: A 24 year-old-male presented initially with a skin abrasion on the left knee and subsequently developed local erythema and swelling. He was treated for non-infectious prepatellar bursitis with brace immobilisation and antiphlogistic medication. After 12 days he presented in septic shock and signs of kidney failure. The left lower extremity was massively swollen and extremely painful. Computed tomography showed epifascial fluid collections and abscess formation circumferentially involving the entire left leg. Empiric IV antibiotic therapy was started with clindamycin and amoxicillin/clavulanate. Guideline conformed septic shock treatment, radical debridement of the epifascial tissue of the entire lower left extremity and subsequent temporary moist packing had to be carried out. There was no evidence of fascial or subfascial involvement. At the end of a planned second look operation after 12 hours a vacuum assisted closure therapy was initiated. Initial wound cultures showed S. aureus and S. pyogenes. The antibiotic therapy was according to the resistance spectrum adapted to IV penicillin four days after admission. It had to be changed to IV cefazoline due to pruritic urticaria and finally a six-week course of oral clindamycin was administered.

Results: In total 8 surgical procedures including minor debridements, change of vacuum assisted closure and finally skin grafting were performed until the patient was discharged to a rehabilitation center after 42 days of hospitalisation.

Conclusion: The clinical features of septic bursitis are sometimes indistinguishable from non-infectious bursitis. Our case shows that there is a strong need for clear clinical parameters such as the Sirs-criteria for decision making. Even in immunocompetent patients a strict monitoring is mandatory as well as a subsequent clinical treatment with a low threshold to early surgical intervention.

P38

Regionally Multiple Spread Pseudomyogenic Hemangioendothelioma around the Foot with Severe Pain: What is the Best Option? *(8270)*

Dr. Pascal Haefeli; Prof. Dr. Gabriela Studer; Dr. Silvia Hofer; Prof. Dr. Bruno Fuchs

Luzerner Kantonsspital

Purpose: Pseudomyogenic hemangioendothelioma (PMHE) is an extremely rare soft tissue tumor with some over 60 cases reported in the literature. It is an endothelial tumor of vascular origin which is rarely metastasizing. It often presents as multiple discontiguous nodules in different tissue planes of a limb, and it may mimic a myoid tumor or epithelioid sarcoma. We herein report on another case of PMHE and discuss the challenging treatment options.

Method: A 20 year old female patient noticed some discomfort in the lateral aspect of her left foot for one year, but more importantly, there were two nodules on the distal aspect of the left leg which really disturbed her. Her physician therefore excised them in local anesthesia from the subcutaneous tissues. It turned out to be a PMHE which was incompletely excised (ie. Whoops lesion). Imaging revealed several nodules within the entire foot with probably the primary lesion of 2.5cm in the lateral aspect. Staging studies were performed, and there were no other lesions found proximal to the mid-aspect of the leg.

Results: Because there is no save limb-salvage option with surgery both locally and oncologically, radiation therapy was performed with a total of 60Gy, including the leg lesions. Staging studies never showed any progress of the disease. Unfortunately, the pain became worse of time, and the patient could not stand on her foot her anymore. After this patient talked to another patient who underwent a BKA years ago also for a sarcoma, we elected to proceed with BKA. The postoperative coure was uneventful.

Conclusion: PMHE is a very rare condition, and therefore its biology is not well known. Although the disease was regionally spread, it did not evidence any progress over 1.5 years during observation, implying the usual dormant course of this disease. Because of clinical urge, we were forced to proceed with surgical therapy.

P39

Iliosacral Resection: Reconstruction Technique sparing the Lumbo-Sacral Junction to preserve Mobility *(8478)*

Dr. Carlo Theus; Dr. Holger Klein; PD Dr. Dezsö Jeszenszky; Prof. Dr. Jan Plock; Prof. Dr. Bruno Fuchs

Purpose: Iliosacral resection for sarcomas are demanding surgical procedures. The Toronto group reports that iliosacral reconstruction is not necessary if the gluteal neurovascular bundle is resected. However, in case of reconstruction, the lumbosacral junction plays an important role because it is often included in the instrumentation, although loosing postoperative functional mobility. The question remains whether a sacro-iliacal/acetabular reconstruction is sufficient to spare the lumbosacral mobility.

Cases: Three patients at the ages of 17, 29 and 63 years, who were diagnosed with a undifferentiated pleomorphic sarcoma of bone, Ewing sarcoma, as well as a non-seminomatous germ cell tumor, underwent sacroiliacal resections. In two patients, the sacral osteotomy was through the ipsilateral foramina; in one patient, the osteotomy was made contralaterally through S2 and S3. The tumors were 119x82x63mm, 51x44x41mm, and 44x40x30mm. In all patients, the gluteal neurovascular bundle was spared.

Results: All three patients had a sacro-acetabular reconstruction sparing the lumbo-sacral junction with pedicle screws, two patients had a ipsilateral vascularized fibula, in the oldest patient, a metal cage was added. The postoperative course in one patient was complicated by a toxic megacolon, the other two patients left the hospital after 1 and 1.5 weeks postoperatively. All patients are ambulatory without crutches.

Conclusion: Both resection and reconstruction of iliosacral tumors are demanding, and the indications for reconstructions are continuously refined. Herein, we present a technique how to place pedicle screws with instrumentation as well as a vascularized fibula in the narrow space after sacro-iliacal resection, sparing the lumbosacral junction to preserve its mobility.

P40

Longterm Followup with Primary UPS of the Posterior Thigh and Isolated Mesenterial Metastasis at 12 year Follow-up *(8479)*

Dr. Carlo Theus; Prof. Dr. Beata Bode; Dr. Felix Grieder; Prof. Dr. Bruno Fuchs

Purpose: Most disease recurrences following the primary treatment of soft tissue sarcomas occur within two years, and metastasis preferentially occur in the lung. Isolated abdominal metastasis from soft tissue sarcomas from the lower extremities occurs only in 3%, and they have a dismal prognosis. They usually occur after 2.4 years, with the longest interval described of 6.6 years. In here, we represent a patient who developed his first mesenterial metastasis from UPS in the dorsal thigh compartment 12 years after initial diagnosis.

Case: A 69 year old patient noticed a history of 6 month long painless swelling in the posterior right thigh of 180x12x10cm, abutting the sciatic nerve. A biopsy revealed an undifferentiated pleomorphic sarcoma, and the patient underwent preoperative radiation therapy with 25x2=50 Gy, followed by R0 resection of the tumor mass. The postoperative course was uneventful, and the patient was regularly followed-up every 3 months for 2 years, then six months until 5 years postoperatively, and then yearly, by using local MR-imaging and CT chest.

Results: Ten years after initial surgery and a completely asymptomatic course, the patient perceived some abdominal discomfort. An abdominal CT scan evidenced a 12cm large mesenterial mass. A biopsy confirmed the metastatic lesion by comparing the tissue with the initial biopsy. The mass was surgically R0 removed, however, within 6 months, the tumor regionally spread, and the patient died 12 months after diagnosis of his abdominal metastasis.

Conclusion: This case presentation describes the longest follow-up of a patient to develop abdominal metastasis. It confirms the exception to the rule of our widely accepted follow-up scheme, not detecting all possible recurrences. A high level of suspicion of recurrence is always indicated in patients who had underwent treatment for a sarcoma independent of the anatomic location.

P41

Soft Tissue Sarcomas of the Iliopsoas muscle: Surgical Approach *(8481)*

Dr. Carlo Theus; Dr. Felix Grieder; Prof. Dr. Beata Bode; Prof. Dr. Bruno Fuchs

Purpose: Traditionally, orthopedic oncologists use the utilitarian triradiate exposure to approach sarcomas in the pelvis. However, for sarcomas of the iliopsoas muscle, the surgical overview might be compromised, and for tumors extending along the lumbar spine, it may not even be sufficient. Herein, we present the pararectal approach to gain wide exposure for the resection of iliopsoas and/or iliac fossa sarcomas.

Case presentation: Two female patients of 31 and 49 years of age, had an extraskeletal Ewing's sarcoma of the iliac fossa of 40x38x36mm, and a malignant peripheral nerve sheath tumor (MPNST) within the iliopsoas muscle at the lumbar pelvic junction of 40x38x36mm. Both patients had preoperative radiation therapy, the first in combination also VIDE neoadjuvant chemotherapy. Both patients underwent surgical resection using the pararectal approach.

Results: The skin incision is centered over the lateral aspect of the rectus abdominis muscle at the level of the tumor, the fascial layers are identified, and the peritoneum is dissected off to remain extraperitoneally. Care is taken on the right side since the coecum may lay retroperitoneally as well, or may be adjacent to the tumor after preoperative radiation therapy. The iliopsoas muscle with its accompanying genitofemoral nerve is identified, then the iliac vessels and the ureter. Together with the tumor, the lumbar plexus with femoral and obturator as well as L5 nerve roots are identified and carefully dissected to identify its relation with the tumor. In both patients, the femoral nerves were resected, in the second patient also the L5 nerve root, whereas the obturator nerves could be spared in both. The postoperative course was uneventful.

Conclusion: The pararectal approach is safe with minimal morbidity, and offers lots of advantages regarding exposure of critical anatomic structures in the pelvis compared to the utilitarian incision.

P42

Extramedullary Spinal Dermoid Cyst extending through the Ilium into the extrapelvic Abductors: Surgical Technique *(8483)*

Dr. Carlo Theus; Dr. Daniel Coluccia; Prof. Dr. Bruno Fuchs

Purpose: Dermoid cysts are rare, congenital, benign and slow growing lesions which develop early in life, as a result from incomplete separation of cutaneous ectoderm from the underlying neuroectoderm. They usually form space-occupying tumors anywhere in the neuraxis and can present with a dermal sinus tract, or acutely after rupture or infection. The management can be tedious as they have the tendency to recur often requiring repeated surgical resections. Spinal dermoid cyst has never been described in the pelvis so far. Herein, we present the surgical approach.

Case: A 30-year old patient presents with a history of 10 months long radicular pain into the right leg and dorsal foot. In retrospect, the patient recalls similar but very slight pain since childhood, but recently of increased intensity. He did not note any reduced sensation and muscular weakness, although the pain intensifies through increased gym activities. MR imaging revealed a 14cm long cystic lesion with fatty content between iliac and psoas muscles, in close contact to the obturator nerve as well as the nerve roots L4, L5 and the iliac vessels, extending through

a separate opening through the iliac bone and gluteal muscles into the subcutaneous soft tissue, without sinus tract. It was decided to surgically resect this lesion.

Results: A posterior intra-extrapelvic approach was chosen with release of the abdominal wall from the iliac crest to expose to gain access to the iliopsoas muscle. We started to expose the extrapelvic part of the lesion by releasing the gluteal muscles extrapelvically. Then the iliac crest bone superior of the intra-extrapelvic connection was removed to expose the entire lesion, sparing the SI-joint. Thereby, we gained intrapelvic access to the lumbar plexus, and the nerve roots could be safely exposed to remove the lesion in its entirety. At 6 months follow-up, the patient was pain free.

Conclusion: This is the first description of a spinal dermoid cyst in the pelvis, with a long clinical history of subtle chronic radicular pain. Complete surgical removal is feasible through a combined extra- and intrapelvic approach releasing the abdominal wall muscles from the iliac crest, to gain access to the lumbar nerve plexus.

P43

Is a reference pathological diagnosis of soft tissue tumors advantageous? A comparative Analysis from the SwissSarcoma-Network *(8487)*

Dr. Hanna Wellauer[1]; Prof. Dr. Gabriela Studer; Dr. Alexander Vogetseder; Prof. Dr. Beata Bode; Prof. Dr. Bruno Fuchs

[1] Kantonspital Winterthur

Introduction: The diagnostics and treatment planning of soft tissue tumors are critically dependent on the pathological examination. Soft tissue tumors are rare tumors and histological examination remains a challenge. 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 often secondarily reviewed by a reference pathologist. Herein, we assessed the time to obtain the final diagnosis, as well as the quality of the diagnosis, comparing direct reference review versus local review first.

Method: We examined retrospectively all pathology reports of patients from two major Swiss referral centers between January 2019 and July 2019, which were presented at the SwissSarcomaBoard. Patients with incomplete records were excluded. Biopsies from institution A were directly read by the reference pathologists, whereas biopsies from institution B were first worked-up and read by local pathology and then sent to the reference pathologist. In a first step, we analyzed the number of working days needed from acceptance of the sample to the final report. In a second step, we compared the provisional and final diagnoses and examined them for any differences.

Results: 127 patients with a biopsy were presented at the SwissSarcomaBoard and included in the study. A total of 53 patients from institution B and 74 patients from institution A were examined. On average, it took a total of 5.8 days for the patients from institution B to complete the final report. In contrast, it took 3.4 days for patients from institution A. The time needed for the examination in pathology is similar in both groups (institution B 3.9 days vs. institution A 3.1 days). According to our interpretation the time difference is mainly caused by the additional expert examination. With regard to the differences in the diagnosis, in 15% of the cases the final diagnosis was only established by the expert pathologist. In additional 7.5% of the cases, the diagnosis of the non-expert pathologist was incorrect compared to the expert opinion.

Conclusion: The histological examination of soft tissue tumors directly by an expert pathologist leads to faster and robuster final diagnosis in soft tissue tumors.

P44

Free vascularized fibula transfers in tumor surgery *(8518)*

Dr. Christophe Kurze; PD Dr. Frank Michael Klenke

Inselspital, Bern University Hospital

Objectives: The reconstruction of bone defects after tumor resection is challenging. The aim of this study was to review our patients who received vascularized fibula Transfer and to identify risk factors for failure of this surgery technique.

Methods: Retrospective, single-center case series with n=13 patients (6 male, 5 female, mean-age 45,8±15,4 years) after free vascularized fibula transfer (5 single-, 7 double-barrels, 1 Capanna). The mean follow up was 107,8±84,0 months. 10 femoral, 2 humeral and 1 metatarsal reconstruction with an average defect size of 14,9±6,1 cm were performed. Diagnoses were: 3 chondrosarcoma, 3 pleomorphic high grade sarcoma, 2 osteosarcoma, 2 rhabdomyosarcoma, 1 fibrosarcoma, 1 liposarcoma, 1 myxoid sarcoma, 1 Plasmozytoma). 6 patients received radiotherapy.

Results: 10 (77%) vascularized fibula reconstructions integrated successfully. 3 (23%) reconstructions failed completely. One after 1 months due to infection, one after 14 and one after 50 months due to non-integration. One patient received a tumorprothesis, the other two were amputated. Overall 4 bone healing associated revisions were necessary. 2 ended in complete failure. 50% of the 4 bone healing associated revisions received radiotherapy. All 4 were located in the femur. Mean defect size was 17,3 cm in that group, mean age was 41 years. Tumors were chondrosarcoma, osteosarcoma, myxoid sarcoma and rhabdomyosarcoma. 2 of these patients died of disease, 2 had no evident disease. 3 soft tissue receipiant site revisions were necessary, however no donor site revision. They all healed eventless after surgical revision. Overall 8 patients had no evidence of disease, 1 had stable disease and 2 were deceased at the latest follow-up.

Conclusion: There are more complications with increasing defect size. The patient's general condition also seems to influence the chances of successful osseous integration. Overall, good vascular integration and stability in tumor surgery can be achieved by using a vascularized fibula transfer.

P45

Enneking Type II Acetabular Hemipelvectomy using the Combination of a modified Stoppa, a modified Smith Petersen and a trochanter flip Approach *(8523)*

Carlo Theus[1]; Dr. Pascal Haefeli[1]; Prof. Dr. Bruno Fuchs[1,2]; Prof. Dr. Martin Beck[1]

[1] Luzerner Kantonsspital; [2] Kantonsspital Winterthur, UniversitätsSpital Zürich USZ, Universitätskinderspital Zürich

Periacetabular resections and reconstruction are amongst the most challenging procedures in orthopedic oncology and the complication and re-operation rate is very high. Over the last decades less invasive acetabular surgical approaches such as the modified Stoppa approach have been described and show promising results. To the best of our knowledge, using an anterior modified Stoppa approach in combination with a modified Smith-Petersen as well as a trochanteric flip approach has not been described in acetabular hemipelvectomy for an oncologic condition.

A 59-year-old male presented with a symptomatic isolated, progressive osteolytic metastasis of the right acetabulum, 8 years after robot guided radical prostatectomy and adjuvant radiotherapy due to adenocarcinoma of the prostate. It was treated with a combination of hormone-, chemo- and radiotherapy. The metastasis was recalcitrant to the treatment and due to pain exacerbation and intra-articular tumor extension, the decision for an Enneking II periacetabular excision and pedestal cup endoprosthetic reconstruction was made. To preserve the posterior column and thus pelvic stability a Ganz periacetabular osteotomy (PAO) was planned.

To spare the origins of the abductor muscles of the hip, we decided to perform a combination of three approaches. A modified Stoppa approach for preservation of the obturator nerve and pubic osteotomy (OT) close to the symphysis was combined with a modified Smith Petersen approach with OT of the AIIS for the PAO. For the extracapsular OT of the proximal femur a trochanter flip approach through a Gibson approach was chosen. Through the same approach the ischial OT for the PAO was performed. After macroscopically complete resection of the tumor, the acetabular reconstruction was performed with a cementless cone prosthesis. Due to subluxation phenomenon of the hip, operative revision was necessary (stem exchange and capsule reconstruction with Trevira®). One year postoperatively the patient shows a good functional outcome with the absence of hip pain on the affected side and excellent abductor strength.

Advantages of this combined hemipelvectomy approach includes the preservation of pelvic stability, preserved attachment of the abductor

musculature, which facilitates mobilization and early weight bearing. The disadvantage is, however, the lack of control over the iliac vessels during the surgery. For selected cases, this approach expands the armamentarium of orthopedic oncologists.

P46

Rare solitary musculoskeletal presentations of tuberculosis *(8546)*

Dr. Christina Sydler[1]; Prof. Dr. Bruno Fuchs[2]

[1] Spital Interlaken; [2] Kantonsspital Winterthur und Luzerner Kantonsspital

Introduction: Solitary musculoskeletal presentation of tuberculosis (TBC) is rare. With some 10%, it is the third most common site of extrapulmonary TBC in the United States. Of these, 50% involve the spinal region, followed by hip and knee as sites of infection. After all, TBC can present in any bone, including ribs and skull, joint, muscle and tendon as tuberculous spondylitis, osteomyelitis, arthritis, myositis or tenosynovitis. Isolated extrapulmonary TBC of the musculoskeletal system is an extremely rare event.

Methods: Three patients at the age of 49, 37 and 35 with a suspicion of soft tissue sarcomas were subjected to US-guided biopsy with local anesthesia. In the first patient, the mass was located in the sacral vertebrae 2 and 3. The patient complained about pain in the sacrum and tuber ischiadicum but was otherwise in healthy condition without fever. The lesion in S2/3 was 12x30x45 mm. There was a destruction of the medial cortex of the S2 foramen with a lytic destruction. In addition, a presacral soft tissue edema and an infiltration of the fatty tissue around the right S2 root was seen in the MRI. In the second otherwise healthy male patient, a 37x17x50 mm lesion was localized in the left pectoralis major muscle. He noticed a painless but growing swelling over 3 months, which started to hurt on pressure or with active contraction of the pectoralis major muscle about 1 month prior to biopsy. In the third clinically asymptomatic patient, a 70x50x30mm lesion was diagnosed in the right pectoralis minor muscle, after a 4-month history of a painless swelling. Based on MR imaging, the suspicion of TBC was included in the differential diagnosis prior to bioptic work-up.

Results: In all cases, TBC was confirmed through histopathological as well as microbiological analyses. No surgery was performed. All patients remained free of any other symptoms. After exclusion of a HIV infection, in all patients a specific therapy with Rimstar (Rifampicin, Isoniazid, Pyrazinamid, Ethambutol) for two months and thereafter Rifampicin and Isoniazid for another 6 months was conducted.

Conclusion: Extrapulmonary isolated TBC of the musculoskeletal system is extremely rare and can be mistaken as a soft tissue sarcoma. In all workups of patients with suspected sarcoma, an infectious origin must be taken into consideration.

P47

Arthroscopically assisted and 3D modelled minimally invasive rim plate osteosynthesis via modified anterolateral approach for posterolateral tibial plateau fractures: technical note (8364)

Dr. Stamen Roumenov Milev[2], PD Dr Marco Delcogliano[1], Dr. Roberto Marin[1], Dr Luca Deabate[1], Dr Davide Previtali[1], Dr Giuseppe Filardo[1], Dr. Paolo Gaffurini[1], Prof. Dr. Christian Candrian[1]

[1] EOC (Ente Ospadaliero Cantonale) - Ospedale Regionale di Lugano, [2] Orthopedics and Trauma Clinic, Department of Biotechnology and Life Sciences (DBSV), University of Insubria, Varese, Italy

Introduction. To describe a new, closed, arthroscopically-assisted reduction of posterolateral tibial plateau fractures with minimally invasive plate osteosynthesis using a plate pre-contoured over a 3D-model based on a CT-scan of the injured tibial plateau and positioned by using a 5-6 cm modified minimal anterolateral approach.

Methods. The patient is supine with the knee 50°-flexed. A 5-6 cm-long curvilinear incision is made over the Gerdy's tubercle. After sub-cutaneous dissection, the fascia is incised, the ileo-tibial band is splitted, and the dissection is extended posteriorly. The knee is flexed to 90° and the para-FCL space is created. A 2.7-mm variable-angle locking compression plate contoured on a 3Dmodel is inserted flush to the tibial plateau rim. Two cortical screws are placed to ensure support under the area of depression as far posteriorly as possible. Two additional screws are implanted, and a cortical screw is used for the most anterior screw hole.

Results. The custom pre-contoured plate based on a person-specific 3D-model, associated with arthroscopy reduction, provides supporting and containing effect to the posterolateral periarticular fragments and allows to perform a minimal invasive plate osteosynthesis fixation. This guarantees a proper reduction and fixation without the described limitations and risks associated with the classic anterolateral and posterolateral approaches.

Conclusions. This approach should be considered to treat fractures of the posterolateral plateau, isolated or associated with medial tibial plateau fractures, as it can improve the outcome of the treatment in terms of lower associated risks, better reduction and fixation, and faster and improved patient recovery.

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Swiss Medical Weekly
Farnsburgerstrasse 8
CH-4132 Muttenz, Switzerland
Phone +41 61 467 85 55
office@smw.ch

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