

ABSTRACTS

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Basic science

EP-001

The biomechanical basis of preventive osteosynthesis for cystic lesions of the proximal femur

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Level III

Purpose The development of benign skeletal tumours in some areas of the femur affects its biomechanics and leads to pathological fractures.

Methods 3D computer models of intact femur, a proximal femur with a cystic lesion, and with different types of osteosynthesis - a locking compression plate (LCP), angled blade plate (ABP) and femoral interlocking nail FIN (femoral interlocking nail) - have been created based on CT scans of the femur by using Mimics and SolidWorks software. These methods of surgical stabilization of the proximal femur were evaluated by ANSYS with Finite Element Method (FEM) comparative analysis of the von Mises stress-strain relations under static load (750 N).

Results The presence of a cystic lesion in the proximal femur shows increased stress and strain up to 67.8% at the upper surface of the neck and up to 34.2% at the lower surface of the neck compared to the intact femur, which indicates a significant risk of fracture. With the LCP and the FIN, the stress on the lower surface of the femoral neck was reduced to 2.09 MPa (65.8%) and 2.07 MPa (66.2%) respectively, but with the ABP the stress decreased only to 7.79 MPa (21.7%). The stress at the upper part of the neck was minimal with

the LCP (1.16 MPa) and increased by 25.5% with FIN (5.8 MPa) and by 15.6% with the ABP (3.9 MPa). The strain at the femoral neck with FIN (0.012 mm) was similar to the strain of the standard model, which was taken as a normal. The strain at the neck of the model was decreased by 75% (up to 0.003 mm) with LCP and 25% (up to 0.009 mm) with ABP.

Conclusion The optimal parameters of the stress-strain relations are achieved from the model with the LCP and FIN.

Sports, Miscellaneous

EP-002

Retained foreign objects in casts - why, and can we do better?

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Level IV

Purpose To determine why foreign objects are retained in casts in the treatment of fractures in children, and to study the effect of these retained foreign objects on adjacent skin.

Methods All children who had a foreign object in the plaster cast at the time of cast removal, were included for study. Patient demographics and reasons for applying the foreign object in the cast were recorded as was the effect of the foreign object on adjacent skin.

Results From June to December 2016, 18 children (13 boys, 5 girls; average 8.9 years) met the inclusion criteria. 12 had upper limb casts, 6 had lower limb casts. Ten children reported severe pruritus as the main reason; the foreign object was used as a tool for scratching. Three children used their casts during play during which the foreign object was inserted. In the remaining five children the foreign object was accidentally 'dropped' into the cast. The most common foreign object was

a pen cap, followed by coins and small toy parts. One child had both a coin and a pen cap in his cast. None returned earlier for retrieval of the foreign object. The effects of the foreign objects included skin erosions and superficial abrasions. One 7-year old boy developed a deep ulcer in his right forearm, requiring regular wound dressing and oral antibiotics.

Conclusion The main causes of retained foreign objects in casts are pruritus and play. In most instances the effect on the skin is mild, but this can be severe with ulceration and secondary infection. This is a first study that examines the reasons for retained foreign objects in casts in children and their effects on the skin. Children should be counselled to return to clinic for cast removal if there is a retained foreign object.

Trauma

EP-003

Gartland II supracondylar fractures of the humerus: what is the best treatment option?

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Level III

Purpose Closed reduction and percutaneous fixation is used for most cases of Gartland II supracondylar fractures. Closed reduction and immobilization according to Blount has been associated with complications, including ischemic contracture and cubitus varus. We aim to compare the results of treatment of Gartland II supracondylar fractures by Blount method (CR-Blount) or closed reduction and internal fixation with Kirschner-wires (CR-KWires).

Methods Case-control study including patients with Gartland-II supracondylar fractures, age 0-12, treated by CRBlount or CR-KWires, period 2009-2015. Data collected from electronic-medical-records. Telephone interviews to assess satisfaction (0-10 points) and function (QuickDASH). Results significant for $p < 0.05$.

Results Included 51 patients (26 males), 52 fractures. Left elbow affected in 39 patients. CR-Blount group included 17 patients, median age 6 years, median 1-day admission, median intraoperative radiation 1.39 cGy.cm², average duration of follow-up 32 weeks, with median 3 weeks to radiographic healing and median 3 follow-up radiographs. Median number of total 2 consultations. Median level of satisfaction 10 points and QuickDASH 0 points. Complications: 1 case of loss reduction needing re-intervention, 2 cases of joint stiffness and 2 cubitus varus. CR-KWires group included 34 patients, median age 5 years, mean hospitalization 1 day, mean intraoperative radiation 16.97cGy.cm², mean follow-up 27 weeks and median time to radiographic healing 4 weeks. There were median 2 radiographs during follow-up and 0-4 follow-up consultations. Average satisfaction was 10 points (8-10), average QuickDASH 0 points. There were 3 complications: 2 joint stiffness, 1 loss of reduction and re-intervention. Comparing the 2 groups, there were no significant

differences in major complications, satisfaction or function ($p > 0.05$). Intraoperative radiation was significantly higher in the group undergoing CR-KWires ($p = 0.001$). The number of follow-up radiographs was significantly higher in CR-Blount ($p = 0.008$).

Conclusion The results of treatment of Gartland II supracondylar fractures are similar for both methods in terms of function and satisfaction.

Trauma

EP-004

Intra-articular radial head fractures: a deceptive type of injury

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Level IV

Purpose Intra-articular radial head fractures in skeletally immature patients represent a rare injury which frequently shows a disparity between the clinical presentation and a very innocent radiological appearance. Despite their radiological benign look, these fractures are at risk for progressive radial head subluxation that may lead to catastrophic degenerative changes of the radiocapitellar joint. The objective of this study was to highlight the seriousness of these injuries and the importance of their early treatment.

Methods We reviewed the charts of the patients treated for radial head/neck fractures at our institution between 2011 and 2016. Six intra-articular radial head fractures were identified. The average age was 11.3±1.3 years. All patients presented a Salter-Harris III or IV fracture. The type of treatment together with clinical and radiological results were analysed. The Oxford Elbow Score (OES) was used to evaluate clinical outcomes.

Results Follow-up averaged 2.4±2.3 years. Three patients were treated with early open reduction and internal fixation within 3 weeks. No limitation of the range of motion (ROM) was detected. Their average OES was 46.7±1.5. All of them presented congruous elbow at the radiographs. Three patients were treated conservatively due to the innocent radiological aspect. All of them developed a posterior subluxation of the radiocapitellar joint, but early displacement was missed, finishing with pain and limited ROM. Two of them underwent a delayed open reduction and internal fixation respectively after 8 and 20 weeks. Surgery did not improve the results. All three patients presented a limited ROM, moderate pain and activity restriction (average OES 33.7±2.8). The radiographs showed enlargement of the radial head.

Conclusion Intra-articular radial head fractures in skeletally immature children are deceptive injuries often unrecognized and underestimated. A prompt diagnosis and an early aggressive treatment are required to avoid a permanent function loss of the elbow.

Trauma

EP-005

Monteggia-like lesion with ulnar plastic deformation in children - a difficult diagnosis

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Level IV

Monteggia fracture-dislocations are rare lesions in children and correct diagnosis is extremely important to avoid elbow dysfunction, the need for open reduction and adult elbow arthrosis. There is a high incidence of misdiagnosis in emergency departments, especially when there is only ulnar plastic deformation and radial head dislocation. These patients are commonly misdiagnosed as having a soft tissue injury. We present the case of a 4-year-old girl, which sustained an elbow trauma while playing on a slide. She was first observed in another hospital, where she was diagnosed with hyperextension elbow soft tissue injury and had her elbow put on a long arm splint for pain control and given instructions to proceed follow up at her local area hospital. After 8 days, she was observed at our hospital, and had new x-rays taken, where there was misalignment of the capitellum with the radius due to anterior radial head dislocation and plastic deformation of the ulna. A Monteggia-like lesion was diagnosed and she was then submitted under general anaesthesia to manipulation, closed reduction and immobilization of the elbow in a long arm splint in 110 deg flexion and full supination. A weekly follow-up showed reduction of the radial head and the splint was removed at 6 weeks. Elbow stiffness was mild with no need for physical therapy. There were no range of motion deficits after 12 weeks and after 6 months anatomic radiological alignment was maintained. Monteggia fractures are uncommon and are rarely seen in most emergency departments. The radial head dislocation is often missed specially if there is only ulnar plastic deformation with no fracture. The majority of radial head dislocations in children can be reduced with manipulation under general anaesthesia but, if the diagnosis is not correct or is made late, open reduction is commonly required.

Trauma

EP-006

Femoral sulcus angle and patella alta correlation for the first time acute patellar dislocation

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Level II

Purpose Lateral patellar dislocation (LPD) is a relatively common injury. The two most important anatomical variants that have been implicated in LPD include trochlear dysplasia, patella alta. How these factors interact and bring patellofemoral instability is still a matter of debate. The aim of the present prospective study was to determine the correlation of patella alta incidence with different femoral sulcus angle in patients with primary LPD history.

Methods 58 patients (boy/girl 23/35; age range 11 to 18 years) with acute primary LPD were selected prospectively. Reposition was done. Clinical examination, X-ray (AP, Merchant views), CT examinations of the both knees. Three study groups (gr.): 14 patients (A gr.) with affected knee sulcus angle (SA) $\leq 138^\circ$; 21 patients (B gr.) with SA from 138 to 145°; and 23 patients (C gr.) with SA $>145^\circ$. Patellar alta and sulcus angle were measured according to the Blackburne -- Peel, Insall-Salvati and Brattstroem methods, respectively. Patients age, gender, height, weight, BMI were statistically similar in the all groups. Statistical analysis: the Mann-Whitney U, chi-square tests and the Pearson correlation coefficient. Significance was set at $p < 0.05$.

Results 71.4% of patients in gr. A and 95.2% in B and 87% C gr. had patella alta. There was a statistically significant difference between patients from the A and B gr. The mean patella alta ratio was 1.15 in A gr. patients, 1.33 in B and 1,33 in C gr. respectively. There was a statistically significant difference between patients from the A and B gr. The patellar alta ratio was moderately (directly) correlated with SA ($r = 0.537$, $p < 0.05$) for A gr. patients.

Conclusion The lower rate of patella alta incidence of the affected knee was observed for patients with $SA \leq 138^\circ$ compared to those with SA from 138° to 145° and more than 145°.

Trauma

EP-007

Retrograde fixation of both bones in paediatric forearm fractures treated with elastic stable intramedullary nailing

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Level IV

Purpose Elastic stable intramedullary nailing (ESIN) is an established method of treatment of paediatric forearm fractures. This study analysed the outcomes of retrograde fixation of both bones.

Methods A retrospective analysis was conducted by reviewing patient records of forearm fractures treated with ESIN with retrograde fixation of both bones. The procedure was performed without having to change the position of the forearm

during reduction nor of the surgeon changing his position with respect to the fracture table. Patients were discharged with an above elbow full cast. Casts were removed at first follow up, one month after surgery.

Results The study included 30 children, 26 male and 4 female. The mean age at the time of injury was 11.7 years (range 6.6 to 14.3 years). There were 11 fractures of the right forearm and 19 of the left. 3 were open (2 Guistillo I and 1 Guistillo II fractures). Fracture healing mean time was 5.3 weeks (range 4 to 8.8 weeks). Nail removal mean time was 6.6 months (range 5 to 10 months). There were 5 cases with pronation and supination deficits. One of these concerned a re-fracture sustained after a new injury, 6 months after hardware removal. In 2 of these there was angulation at final follow up, however, in the one, no cast was used post operatively and in the other too thin nails were used. There were no entry point complications. The ulna is sometimes complicated by nonunion in case series of forearm fractures and this could potentially be related to antegrade nailing. There was no nonunion in our series.

Conclusion Retrograde fixation of both bones when treating paediatric forearm fractures with ESIN is a safe, effective alternative to common fixation (retrograde radial fixation and antegrade ulnar fixation), offering practical and technical advantages.

Trauma

EP-008

Treatment of pelvic fracture in children

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Level IV

Purpose Treatment of pelvic fractures in cases involving severe trauma and multiple injuries can be difficult. Furthermore, there are few reports on paediatric pelvic fractures. We reviewed the cases of pelvic fracture in children seen at our emergency department.

Methods We reviewed the records of pelvic fracture patients aged less than 15 years who presented at our emergency center from 2010 to 2017. The study items were injury cause, surgery, external skeletal fixation, Injury Severity Score, haemoglobin value, blood transfusion, Key and Conwell classification of pelvic fractures, and concomitant injuries.

Results Of the 220 pelvic fracture patients seen in the study period, 10 were aged less than 15 years. The average age of these 10 patients was 7.8 years (range 1--15 years), and eight were males. The cause of injury was traffic accident in seven cases, and fall from a height in three. One of ten cases (10%) died. Two patients underwent surgery (open reduction and internal fixation in one, and external skeletal fixation in the other). The average Injury Severity Score was 26.8 points

(range 5--51 points). In six cases the haemoglobin level was 2.5 g/dl or more below normal (13 g/dl). Blood transfusion was performed in six patients with anaemia. According to the Key and Conwell classification system, there were three class I cases, four class II cases, two class III cases, and one class IV case. Concomitant injuries included head trauma in three cases, intraabdominal organ damage in five, and limb fracture in six.

Conclusion We reported on pelvic fractures in children seen at our hospital. Death occurred in one of ten cases (10%). In cases of pelvic fracture in children, attention must be paid to future growth disorders and dysfunction.

Congenital, Syndromes, Skeletal dysplasias

EP-009

Quantitative analysis of a 'last ditch' controlled frame destabilization simulated by a novel 'spacer sleeve' device in limb lengthening patients: a pilot study

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Level IV

Purpose During the consolidation phase of distraction osteogenesis, the bone mineralisation in regenerate may enter a stage of stasis, increasing both treatment time and chances of fixator related complications. Decreasing the rigidity of the implant by controlled frame destabilization particularly by serial pin removal is a familiar yet unquantified last resort to improve bone mineralization in fractures and regenerate alike. We designed a novel 'spacer sleeve' device to simulate serial pin removal in limb lengthening patients using LRS-Orthofix with an intention to make pin removal pain-free, reversible and an outpatient procedure. The aim of the study was: to objectively quantify the effect of spacer sleeve that simulates pin-removal on regenerate consolidation by serial Dual-energy X-ray absorptiometry (DXA) scans.

Methods Limb-lengthening patients with late stasis were retrospectively evaluated for Spacer usage, patient and limb lengthening procedure details, any absolute Bone Mineral Concentration (BMC)% changes and rate of BMC% change after spacer application using DXA scans.

Results Six pilot patients (5 achondroplasia and 1 post-infection limb length discrepancy patient) mean age 15.8 years with a total of 7 long bones sites required spacer sleeve application (six femurs and one humerus). The mean rate of BMC% change per day was recorded as 0.57%/day for regenerate. The paired t-test showed a statistically significant change in BMC% after spacer application at regenerate site (p=0.012). The rate of BMC% change had no correlation to patient factors like age, the timing of spacer application, length of regenerate or rate of BMC change during distraction phase, hinting that spacer sleeve probably improved bone mineralisation independent of patient and bone factors.

Conclusion 'Spacer sleeve' device which stimulates serial pin removal showed a significant quantifiable improvement in the bone mineralisation of the regenerate in this small sample pilot study. A larger prospective study is planned to further validate application.

Congenital, Syndromes, Skeletal dysplasias

EP-010

Clubfoot associated to Down's syndrome treated by Ponseti method

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Level IV

Purpose The association of Down's syndrome (trisomy 21) with clubfeet is not very common. The treatment in this deformity in Down's Sd has been described by Miller PR et al (Orthopaedics 1995) authors recommended surgical treatment to get acceptable results. Nowadays Ponseti method is considered the gold standard treatment for Clubfoot including sindromic but any homogeneous series of DownsSd and clubfoot has been previously reported. The aim was to review clinical features, treatment and follow up of a homogeneous series clubfoot and Down Sd treated with Ponseti method.

Methods Retrospective analysis of patients with clubfoot associated to trisomy 21 (all of these noted by chromosomal analysis) born between 1999-2010. Ten clubfeet were identified for review.

Results Five patients all with bilateral clubfoot were treated by the same senior orthopaedic surgeon with Ponseti protocol. Average age at beginning of treatment: 9m (1m to 30m). Two patients have been treated previously (one conservative and one posterior release). Average number of casts: 3 (2 to 6), 6 feet needed Achilles tenotomy (60%), all of them obtained full initial correction; all were enrolled to brace protocol. Complications: one case had skin sores because corticoid for leukaemia. Three of the 5 patients had no brace compliance (one lost at follow-up for death due to leukaemia). No need of joint or bone surgery and no of the 8 feet at last follow-up (7-15 years) presented relapse. Functionally all 8 feet are painless, functional, flatfeet and with typical first toe adduction.

Conclusion Even though the previous reports recommended surgical treatment, this series demonstrates that Ponseti method obtains excellent results without any need of surgery. No relapses were observed (the minimum follow-up is 7 years). Significance: Unique series of clubfoot associated to Down's syndrome treated with Ponseti method.

Neuromuscular

EP-011

Diversities of neck-shaft angle of proximal femur in patients with spina bifida

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Level III

Purpose Deformities of proximal femur are common in patients with spina bifida (SB) and generally assumed as a part of sequelae of paraplegia, including muscle imbalance and impaired motor function. Neck-shaft angle (NSA) on plain radiograph is the most common sign of proximal femoral deformity and amount of NSA correction indicates postoperative stability of hip. The aim: to assess diversities of NSA of features of proximal femur in children with SB.

Methods In 414 children examined from 2006 to 2016 NSA was calculated on AP radiographs of hips. Neurosegmental level of SB according to the Sharrard classification and motor status by Hoffer's criteria were evaluated.

Results From total amount of 828 hips in patients with SB, NSA was within normal age-matched values in 126 (15,2%). Most of patients (85,6%) with normal values of NSA had level I motor status by Hoffer. Increased NSA (coxa valga) revealed in 678 of 828 hips (82%). In 24 (2,8%) hips decreased NSA (coxa vara) was seen. We divided "coxa vara paralitica" into 3 types according to Weisl classification: 1) spontaneous separation of upper femoral epiphysis; 2) spontaneous fractures of the neck of the femur; 3) iatrogenic avascular necrosis of upper femoral epiphysis. All 3 types of varus deformity were seen in our series. Lysis of the femoral neck was found in 6 hips. All the patients with coxa vara had thoracic or L1-L2 neurosegmental level and were non-ambulators. They had no pain in the hip joints and no contractures, which could interfere with using a wheelchair.

Conclusions NSA correlates with neurosegmental level and motor status of patient. Coxa vara is relatively rare variant of deformity in children with SB. Nevertheless, taking into consideration of this type of hip morphology and parallel assessment of neurosegmental and functional level is crucial to avoid unnecessary treatment.

Neuromuscular

EP-012

The radio-transmitter motion capture system for gait analysis of cerebral palsy

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Level IV

Purpose Although motion analysis has become essential to evaluate the gait of cerebral palsy (CP), optical motion capture system is expensive. We introduce relatively low-price radio-transmitter motion capture (RTM) system for gait analysis.

Methods We evaluated three children before and after muscle releases in the lower limbs for CP. We measured the range

of motion of the hip and knee with the Myomotion System (Naroxon, USA). We evaluated the hip flexion angle (HF), the hip internal rotation angle (HI) and the knee flexion angle (KF) in midstance.

Results Case 1. Age 6, boy. Gross Motor Function Classification System (GMFCS) 1. HF became from 33.6 to 67.5 degrees in right and from 38.5 to 52.3 degrees in left. HI became from 10.2 to 6.4 degrees in right and 29.2 to 8.5 degrees in left. KF became from 28.0 to 20.9 degrees in right and 33.9 to 13.7 degrees in left. Case 2. Age 4, girl. GMFCS 3, walker-gait. HF became from 48.6 to 34.2 degrees in right and 31.4 to 31.7 degrees in left. HI became from 19.7 to 6.9 degrees in right and 45.2 to 27.6 degrees in left. KF became from 34.5 to 19.8 degrees in right and 35.3 to 17.4 degrees in left. Case 3. Age 8, boy. GMFCS 2. HF became from 49.7 to 30.0 degrees in right and 46.4 to 35.7 degrees in left. HI became from 13.1 to 3.7 degrees in right and 49.3 to 21.5 degrees in left. KF became from 54.4 to 22.8 degrees in right and 46.2 to 31.0 degrees in left.

Conclusion RTM system was useful for gait analysis even for the patient of walker-gait. After muscle releases of lower limbs, the hip internal rotation and the knee flexion in mid-stance were improved.

DDH

EP-013

20-year data of hip dysplasia screening within Cornwall, United Kingdom

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Level III

Purpose Developmental dysplasia of the hip (DDH) affects 1-2/1,000 babies and delayed presentation is associated with poor outcomes and increased need for surgical intervention. Current screening within the National Health Service (NHS) for DDH involves clinical examination within 72 hours and is repeated at six to eight weeks. Previous studies have shown that clinical examination is sensitive but has poor specificity (97% and 13.68% respectively). This study presents a retrospective case series of 21,830 patients referred to a DDH ultrasound screening service over 20 years. Demonstrating a cost-effective screening process with good results via conservative treatment and reduction of late presentations.

Methods A retrospective analysis of the clinical findings, ultrasound results and outcomes was undertaken. These results were correlated with patient notes. The definitive treatment of all patients and the numbers of late presentations over time was analysed. Correlation for risk factors and ultrasound findings highlighted major risk groups that may benefit from a global screening process.

Results Patients were referred from several sources most notably obstetrics 69.81%. 268 clinical examinations (1.23%) were found to be unstable or dislocated, while 886 incidences

of ultrasound instability were noted (4.06%). A cohort of 593 patients is noted to have normal clinical examination but abnormal ultrasound. In this series the specificity and sensitivity of clinical examination was 99.64% and 12.11% respectively.

Conclusion This series demonstrates an effective screening of the population of Cornwall highlighting the need to use multiple modalities in the assessment of DDH. It is proposed that this should be rolled out to screening of all infants especially in high risk groups as highlighted from our results i.e. breech presentation and first born. Further research should be performed on screening high risk populations with or without signs and symptoms.

Foot

EP-014

Pirani and Dimeglio score systems for evaluation of idiopathic clubfoot really have high inter-observer reliability?

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¹AOU Meyer

Level II

Purpose Classification systems are used to differentiate the deformities, evaluate progression/regression during treatment and provide a prognostic value on the long-term. The classifications most commonly used include the Pirani and Dimeglio systems, both proved to have high inter-observer reliability in the total score. Only few studies reported the agreement of the individual parameters of Pirani system. The individual parameters of Dimeglio classification have never been assessed. The purpose of our study was to assess the reliability of the individual parameters of both systems and to identify the most critical aspects.

Methods 35 patients with idiopathic clubfoot and managed by the Ponseti method were enrolled. Every foot was independently evaluated during treatment by 2 paediatric orthopaedists (3 involved). Both Pirani and Dimeglio score systems were analysed. The data were analysed using the Pearson correlation coefficient, P-value and K-statistic.

Results Of the 35 children, 22 presented bilateral and 13 unilateral deformity (57 feet). Each foot was evaluated twice, for a total of 288 single evaluations. The Pearson correlation coefficient was 0.91 and 0.87 ($p < 0.0001$) for Pirani and Dimeglio classification respectively. The K-values observed for the Pirani were rated moderate for posterior crease, empty heel, medial crease, lateral head of talus and substantial for rigid equinus and curved lateral border. The K-values observed for the Dimeglio were rated fair for adduction, moderate for varus, equinus, calcaneo-midfoot rotation, medial crease, posterior crease, cavus and substantial for abnormal musculature.

Conclusions Our results confirm the high inter-observer reliability in the total score of both systems and the lower reliability of some aspects of Pirani classification. For the first time it is assessed the agreement of individual signs of Dimeglio

system. The low agreement of some parameters underlines the need to improve actual systems, some of these parameters might be improved/eliminated in future.

Foot

EP-015

Bioabsorbable pin fixation and drilling in the treatment of osteochondritis dissecans of the talus in children

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Level IV

Purpose Osteochondritis dissecans of the talus in children is rare, and the literature provides little data to guide treatment. The purpose of the present study was to evaluate our clinical and radiographic results with surgical treatment of these lesions with bioabsorbable pin fixation and drilling.

Methods We retrospectively evaluated all patients with osteochondritis dissecans of the talus who underwent surgery for the treatment of these lesions that failed conservative treatment. Preoperative and latest postoperative radiographs and MRI were used to determine degree of healing. AOFAS Ankle/Hind foot scale and visual analogue scale for pain were used to evaluate clinical outcomes.

Results A total of 9 children (5 females, 4 males) were identified (9 ankles). The mean age was 13,71 years (range, 9,5 - 15,5 years), and median follow-up was 47 months (range, 25 to 58 months). The duration of symptoms ranged from 3 months to 4 years. All lesions involved the superomedial part of the talus and were stage III according to International Cartilage Repair society. No previous injury was reported. All lesions were fixed with one or two bioabsorbable pins (1,5mm diameter) and drilling of the lesion. On postoperative MRI, the lesion appeared completely healed in 4 cases and partially healed in 5 cases. All patients were satisfied with surgery and returned to their previous level of activity. The average AOFAS Ankle/Hindfoot score improved from 65 points (50 to 72,) preoperatively to 96 points (90 to 100). Visual analogue scale also improved from 5,8 (4 to 8) to 0.4 (0 to 2).

Conclusion Surgical fixation of osteochondritis dissecans lesions of the talus in children with the use of bioabsorbable pins and drilling produces a high rate of satisfaction and is an effective option for these patients.

Knee

EP-016

Modified Stanislavljjevic procedure for treatment of permanent or habitual patellar dislocation

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Level IV

Purpose Dislocation of the patella in children is a complex problem which may pose a surgical challenge. We performed modified Stanislavljjevic procedure for congenital and habitual patella dislocations. We added VY lengthening or fractional lengthening of the quadriceps to originally described. The aim of this study is to evaluate the outcome of modified Stanislavljjevic procedure.

Methods We present a retrospective case series, summarizing our results with a surgical technique, modified Stanislavljjevic procedure, for the correction of patellar dislocation. 4 consecutive patients (5 knee, 2 males and 2 females) underwent modified Stanislavljjevic procedure in our hospital from 2012 to 2016. The mean age of the patients at surgery was 12 years 2 months. All patients had an underlying diagnosed genetic background (Down syndrome, chondrodysplasia punctata, achondroplasia, proximal femoral focal deficiency). Mean follow-up was 44 months. The outcome measures were knee ROM, Dugdale classification Grade, Sulcus angle.

Results All patients gained stable patella with no recurrence of dislocation. Postoperative knee active extension was improved significantly for all patients. The preoperative Dugdale Classification grade, 2 of 5 knees were Grade 3, 1 of them was 4, the other two was 5. All of them improved to Grade 1 at final follow-up. The mean of preoperative Sulcus angle was 171.6° and the mean of postoperative Sulcus angles was 158°.

Conclusion All patients gained stable patella with no recurrence of dislocation by modified Stanislavljjevic procedure at final follow-up. To gain the stability of patella in maximal flexion during operation brings good outcome.

Foot

EP-017

Radiological changes after selective soft-tissue release for idiopathic clubfoot and their prognostic value

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Level III

Purpose We have performed selective soft-tissue release (SSTR) for the patients who exhibit residual or recurrent clubfoot deformity after initial Ponseti treatment. However, some patients have a re-recurrence of the deformity after SSTR. We measured the radiological changes of patients' feet and investigated their prognostic value on the re-recurrence.

Methods All consecutive patients with idiopathic clubfoot who underwent SSTR in 2005--2013 in a tertiary-care hospital due to residual/recurrent deformity after Ponseti treatment were analysed. The clinicoradiological characteristics before and after SSTR and during the follow-up were recorded. The ability of radiological factors to predict re-recurrence of clubfoot deformity was assessed by multivariate analysis. During this analysis, the rigid deformities of forefoot adduction, hindfoot varus, and equinus were examined separately.

Results Forty-three patients with sixty-four clubfeet were included. SSTR significantly improved the talo-1st metatarsal angle on the anteroposterior view, the talocalcaneal angle on the lateral view, and the tibiocalcaneal angle on the lateral view. The postoperative improvement of these three angles independently predicted re-recurrence after SSTR. Additionally, the preoperative talocalcaneal angles on the anteroposterior and lateral views were also a significant prognosticator.

Conclusion SSTR seems to be an effective surgical modality showing radiological improvement, but its ability to correct the talocalcaneal alignment is limited. The present results may be useful for predicting whether to add additional surgeries to SSTR or to apply more extensive surgery instead of SSTR.

DDH

EP-018

Radiographic prediction using magnetic resonance imaging of the labrum and the cartilaginous acetabulum in the toddlers with developmental dysplasia of the hip

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Level III

Purpose It is difficult to predict the sufficiency of acetabulum remodeling, which is often evaluated only on plain radiographs in the toddlers with developmental dysplasia of the hip (DDH). The purpose of this study is to investigate the advantage of magnetic resonance imaging (MRI) for prediction of the acetabular development in childhood.

Methods We included 21 hips in 20 patients with DDH (dislocation) who had been performed plain radiographs and MRI scans at the age of 2. In the coronal plane of MRI, we measured the cartilaginous center-edge angle (CCEA), the cartilaginous acetabular-head index (CAHI), and the labral obliquity (LO), which we defined as the angle the labrum made with a horizontal line. For classical bony morphological assessment, the AI and OE angles; instead of CEA, were measured on the radiographs taken at age 2. The radiographs taken at age 6 were evaluated using modified Severin's classification, in which we defined the good-outcome group as Severin I or II, and the poor-outcome group as Severin III or IV. The mean values of each good-outcome group and poor-outcome group were compared, and reasonable cut-off values for outcome were elicited, drawing ROC curve.

Results Between the good-outcome group (7 hips) and poor-outcome group (14 hips), there were significant differences; p-value < 0.05, in CCEA (15±7° vs 6±7°), CAHI (66±8% vs 58±8%), and LO (28±5° vs 22±7°). There was no difference in all parameters of plain radiographs. Additionally, the reasonable cut-off values were 10° of CCEA, 60% of CAHI, and 24° of LO.

Conclusion The MRI findings of cartilaginous morphology of the acetabulum were evaluated, and the reasonable cut-off values for outcome were found. MRI evaluation is useful in the treatment of toddlers with DDH.

DDH

EP-019

Cross-sectional survey of childhood acetabular development

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Level IV

Purpose We have few epidemiological information about normal acetabular development in childhood. About 70% of patients with hip osteoarthritis are female with acetabular dysplasia and no history of hip dislocation in Japan. Therefore, we believe that the reference index in childhood is revealed to survey of acetabular development of Japanese children.

Methods We evaluated 211 radiographs (105 female, 106 male) of intact hips of children with transient synovitis of the hip, aged 3-9 years, excluding patients who complained about their bilateral coxalgia on their first visit and/or those who had previously received a diagnosis of the acetabular dysplasia. We measured the acetabular index (AI), center-edge angle (CEA), and acetabular head index (AHI).

Results AI and AHI of both boys and girls, and CEA of girls were not correlated with age (Pearson's correlation analysis; p>0.05). CEA of boys showed a slight correlation with age (R=0.31, p=0.001). The average of AI was 20±4° vs 18±3° (p<0.01), AHI was 81±7% vs 83±6% (p<0.01), CEA was 24±5° vs 25±5° (p=0.43), in females and in males respectively. Four percent of females aged from 6 to 9 were categorized into Severin's group III (CEA is less than 15°).

Conclusion This survey revealed that acetabular development has been different between male and female patients since childhood, and that it is more dysplastic in female patients. Severin reported that all hips belonging to group III had a history of dislocation, but 4% of females without any history of dislocation belonged to the same group in Japan. Namely, double standard deviations (SD) for hip dysplasia in females showed that AI was 28°, AHI 67%, and CEA 14°. These values might be prognostic indicators for hip dysplasia in adulthood.

Basic science

EP-020

Percutaneous metaphyseal juxta-physeal perforations: a new potential approach to limb lengthening and angular correction

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Level II

Purpose Bone lengthening has developed considerably during the last decades and is mainly based on the callotasis principles. Many complications of lengthening procedures are reported in the literature, the number of which increase with the number of required lengthening sessions to achieve limb equalization. We postulated that percutaneous juxta-physeal perforations could improve bone growth while decreasing the risks related to lengthening procedures and this study was undertaken to test this hypothesis.

Methods This is an IRB approved experimental study on 10 New Zealand white rabbits aged between 8 and 9 weeks who underwent percutaneous image guided juxta-physeal perforations at the right proximal tibia, whereas the left tibia served as control. Radiological controls were performed monthly to measure the longitudinal growth and any angular deviation of the operated and non-operated tibias. A paired 2-tailed t-test was used at the end of the experiments to compare the differences in growth between the right side (operated) and the left side (control). After completion of the study, the rabbits were sacrificed and a histopathological study was undertaken.

Results The operated tibia became longer than the non-operated one by 3.06 mm±2.09 at week 4; 4,13mm±1.8 at week 8; and 4,66mm±1.88 at week 16. There has been also an increasing valgus of the operated tibia of +0.38 deg at week 4; +3,88 deg at week 8, and +4.7 deg at week 16. The left (control) tibia showed initially a varus deviation followed by a trend to approach its starting angle over time.

Conclusion Percutaneous metaphyseal perforations have shown to produce limb lengthening and angular deviation in New Zealand rabbits, probably through an increase in physeal activity induced by hyper-vascularization. They may be used in children as an adjunct or in alternation with serial lengthening in severe limb length inequality, thereby reducing lengthening complications.

Basic science

EP-021

Reliability of subject-specific 3D reconstruction of the rib cage using EOS system in AIS subjects

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Level III

Purpose Adolescent idiopathic scoliosis (AIS) is a deformity of the spine and the ribcage in the 3 planes. The assessment

of rib cage morphology is essential to evaluate the severity of the scoliosis and its evolution. The EOS® biplanar X-ray system allows us to perform a 3D reconstruction of the ribcage at a low dose of radiation, in standing position. The aim was to assess the repeatability of these reconstructions in subjects with AIS.

Methods 30 subjects with AIS (27F, age:16±2years) age-matched to 10 typically developing (TD) adolescents (5F) had undergone EOS X-rays. AIS subjects were divided into 3 groups of 10 subjects each based on coronal Cobb: Gr1, Gr2, Gr3. Six trained operators performed 3D reconstructions of the rib cage, 3 times each. Collected parameters were: maximum thickness, maximum width, gibbosity, rib cage volume, volumic spinal penetration index. Repeatability was assessed using the Intraclass Correlation Coefficients (ICC). The 95% confidence interval (CI), including both intra and inter-observer variability, was calculated (ISO standard 5725-2). Differences between groups were assessed by comparing variability of each parameter. The necessary time for 3D reconstruction was collected.

Results ICC was higher than 0.98 for all parameters. The gibbosity had a 95%CI ranging between 2.2° and 3.2°. The variability was significantly larger in Gr3 for the maximum width (p=0.046) and the rib cage volume (p=0.045). Each 3D reconstruction took between 15 and 20 minutes depending on the severity of the scoliosis.

Conclusion Subject-specific 3D reconstruction of the rib cage, based on biplanar X-rays, was shown to be repeatable in TD adolescents and AIS subjects. The maximum width and the volume of the rib cage were less repeatable in subjects with AIS with a coronal Cobb larger than 40°. This may be due to the severity of the deformity.

Basic science

EP-023

A novel surgical technique for re-tensioning partial ACL tears: biomechanical analysis

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Level III

Partial ACL tears represent a treatment challenge, as any resulting instability is often approached with debridement and complete replacement of the remaining lax but otherwise intact ACL tissue. We assessed whether a novel technique of centralization and re-tensioning of the remaining tissue, via a coring osteotomy, could restore joint stability after a partial ACL tear. Adult cadaveric knees (n=6) were used for testing. Initial measurements were obtained with an intact ACL, mounting the knees at 90 degrees of flexion in an MTS Bionix machine and testing for baseline anterior tibial translation and internal/external rotation. The anteromedial bundle of the ACL was then transected for each specimen, and testing was repeated with only the posterolateral bundle intact. Then an

oblique anterior tibial coring osteotomy was performed, and the posterolateral bundle was centralized by internally rotating the tibial insertion of the ACL 90 degrees. The osteotomy was then fixed using a screw, with the posterolateral bundle under a distalizing tension, and post-intervention measurements were obtained. Anterior translation with anterior drawer testing for the intact ACL was, on average, 8.14 ± 1.65 mm for the four specimens. Following sectioning, the average anterior translation increased to 9.12 ± 2.02 mm, and after retensioning it fell to 7.43 ± 1.86 mm. The repaired ACL had an anterior translation of approximately 8.72% less than the original, intact ligament. Rotational translation at baseline was 52.7 mm and was not significantly different post-sectioning (52.7 mm) or after repair (52.8 mm). Two specimens were excluded as the remaining sectioned ACL failed with loading. Based on our results, this technique offers a potentially viable method for restoring stability to the knee, while maximally preserving native ACL tissue and its neural innervation for partial ACL tears with sufficient remaining tissue. Retensioning also offers mainly bone-to-bone healing, which could allow for a quicker return to sports.

Hip

EP-024

Is the triple osteotomy superior to the Salter osteotomy for improving containment in LCPD?

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Level III

Purpose Precondition for a good outcome after LCPD is containment, otherwise surgery is indicated. Recently pelvic osteotomies play an increasing role. Therefore, the objective of this study was to find out which of the proposed pelvic osteotomy techniques is superior to restore containment.

Methods 106 patients (17 girls, 89 boys, mean age 7,5 ys.) were included. Inclusion criteria were: unilateral LCPD, Salter or Triple-pelvic osteotomy, availability of x-rays of the pelvis preoperatively, 3 and 12 months postop. X-rays were analysed for migration index (MI), amount of decentration (differences between distance 'tear drop to medial epiphysis' (tear-drop-distance) and 'midpoint femoral head and acetabulum' (midpoint-distance) on involved and non-involved side) and center-edge-angle (CE).

Results 89 patients (84%) received a triple osteotomy (TO) - 72 in combination with a femoral osteotomy -- and 17 a Salter osteotomy (SO) in combination with a femoral osteotomy. Femoral osteotomy was performed predominantly for improving rotation. At time of surgery the groups were comparable with respect to Catterall and Herring classification as well as the decentration parameters. Postoperatively the following improvements could be found: In the TO-group the parameters MI, 'tear-drop-distance', 'midpoint-distance' and CE improved significantly postoperatively. In the SO-group

the following results were obtained: MI, 'tear-drop-distance', 'midpoint-distance' and CE.

Conclusion The postop analysis showed for both types of pelvic osteotomy a significant improvement of containment and femoral head coverage which was more pronounced for the triple osteotomy (MI, CE). Follow-up-studies will show whether this will lead to an improved final outcome.

Sports, Miscellaneous

EP-025

Testicular radiation exposure in paediatric orthopaedic surgeons

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Level II

Purpose Testicular radiation has been linked to diminished spermatogenesis and male infertility. The purpose of this study is to determine factors associated with increased testicular radiation exposure in male paediatric orthopaedic surgeons.

Methods A life size whole body anthropomorphic phantom simulating an orthopaedic surgeon was positioned adjacent to a standard radiolucent operating table. A digital dosimeter was attached to the perineal region. Scatter radiation dose equivalent rates were measured during continuous anteroposterior C-arm fluoroscopy of a forearm/hand phantom (simulating a paediatric extremity). Four trials were conducted using three different protective lead aprons (cross-back, full-skirt and half-skirt) in three different positions (standing, sitting with knees 10cm apart and sitting with knees 25cm apart). Radiation dose-equivalent rates were compared using the Student's t-test and analysis of variance.

Results No radiation (0.0 mrem/min) was detected in the standing position and when sitting with the knees 25cm apart using all three aprons. When sitting with the knees 10cm apart, the mean dose equivalent rate of radiation was higher using the half-skirt (0.03 mrem/min) than the cross-back (0.0 mrem/min) and skirt aprons (0.0 mrem/min) but did not reach statistical significance ($p=0.44$). When no lead was used, the mean dose equivalent rate of radiation was significantly higher in the standing position (0.3 mrem/min) than when sitting with the knees 10cm apart (0.15 mrem/min) and 25cm apart (0.1 mrem/min) ($p<0.001$). For all apron types and all positions, the use of an apron resulted in significant decreases in radiation exposure when compared to no protection ($p<0.001$).

Conclusion Lead aprons are effective at preventing testicular radiation exposure in both standing and sitting positions. As the only detectable radiation exposure occurred using a half-skirt apron when sitting with the knees spread 10cm apart, cross-back and full-skirt aprons may provide slightly enhanced protection over half-skirt aprons in the sitting position.

Sports, Miscellaneous

EP-026

Measuring leg length using a ball-marker as a calibration reference on computed radiograph (CR) and EOS: is it accurate or reliable?

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Level IV

Purpose The accuracy and reliability of using a calibration tool, has not been studied extensively. This study compares four methods of calibration between CR and EOS images.

Methods Four CR and EOS anterior-posterior lower extremity views were obtained of a skeleton model, with and without soft tissue, calibrated and not calibrated. Three 1-inch stainless steel balls were positioned at the hip, knee and ankle. A metal ruler was placed behind the skeleton. Four trained reviewers measured the four images 15 times. All images were measured at a minimum interval of 14 days between two events. Mean ranges, standard deviations, the inter-class reliability (ICR), and interclass correlation coefficient (ICC) were calculated to assess the degree of reliability and the correlation between Event 1 and Event 2. ANOVA was calculated to determine accuracy of reviewers by bone tibia versus femur, calibration tool and soft tissue status. Means for the quantitative variables were compared with ANOVA for comparing paired means. Significance was defined as a p value equal or less than 0.05. Bonferonni post hoc test was used to identify significant differences between raters. Significance was established at $p < 0.05$ for all tests.

Results We found significant variability in the values obtained. There were significant differences in the measurements obtained by different fellowship-trained observers, between the same observers, and even with the same observer at different times. The position or use of the calibration tool, radiographic modality, or soft tissue did not yield consistent results.

Conclusion The use of a calibration tool did not guarantee more accurate measurements of leg length even with highly trained reviewers. The variability in measurements can influence prediction of timing of deformity correction procedures. More accurate and reliable methods to calibrate images are needed to improve surgical planning in deformity correction.

Infection, Tumours

EP-027

Spondylodiscitis in children: adequate treatment provides good functional results

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Level III

Purpose Spondylodiscitis is a primary infection or autoimmune inflammation of the intervertebral disc space and vertebral endplate, being a rare condition in children, with insidious signs but potentially devastating consequences. We aim to present the results of treatment of spondylodiscitis in children, in our institution.

Methods Retrospective study of patients admitted to our Hospital, with diagnosis of spondylodiscitis, period 1987-2012, confirmation by imaging and minimum 5 years follow-up. Epidemiological variables, initial symptoms, time to diagnosis, laboratory data, imaging, biopsy need, type and duration of antibiotic therapy, complications and sequelae were evaluated. Functional status evaluated using Back Pain Index.

Results 26 patients included. Median age 2 years (1-10), 57% girls. Most frequent locations L4-L5 (34%) and L5-S1 (27%). Median time of symptoms at diagnosis 15 days (1-45 days). Most frequent symptoms: sit inability (42%) and low back pain (42%). Fever in 31% of cases. Laboratory: median leukogram 11.15×10^9 ($5.8 \times 10^9 - 27 \times 10^9$), median CRP 2.2 mg/dL (0.2-20.3mg/dL) and median ESR: 67.5 mm/h (18-114mm/h). Positive haemocultures in 4 cases (15%). Scintigraphy performed in 77% of cases, MR in 54% and CT in 19%. No patient underwent biopsy. Most commonly used antibiotic was flucloxacillin (77%), median time of intravenous antibiotic therapy 8 days (4-27 days) and total duration 35 days (15-60 days). Median follow-up 85 months (33-276 months). Radiological sequelae in 61% of patients and median Back Pain Index score 4% (0-12%).

Conclusion Spondylodiscitis should be considered in presence of pain, inability to sit, pain or non-specific irritability, even in the absence of fever or laboratory changes. When the diagnosis is suspected, empirical antibiotherapy should be started. Biopsy is not necessary if there is good clinical response. Conservative treatment provides good functional results, in spite of radiological changes.

Infection, Tumours

EP-028

Septic bone and soft tissue defects in children

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Level IV

Purpose Infective bone defects in children is a rare devastating condition. The principles of treatment are derived from treatment of adults as multiple stages, radical resection of infected bone and great concern of the size of the defect. So, this series is based on the application of the law of tension stress and the biologic abilities of the paediatric bone.

Methods 15 cases with post-traumatic infected bone defects of the lower limb. The magnitude of the defect ranged from 1 to 23 cm. There were soft tissue defects in 9 cases. Age of the patients ranged from 2 to 15 years with an average 8 years. The average number of previous operations was 2. All

patients were treated by one stage protocol including bony and soft tissue procedures: minimal debridement, circular fixator was applied and bone transport. Osteoplastic procedures were performed concomitantly. The organism was MRSA in 10 cases. The patients were assessed clinically and radiographically pre- and postoperatively, every 2 weeks till fixator removal and then every 6 months.

Results After an average follow up period 2 to 15 years, union was achieved in all cases except one. Only 3 cases had shortening more than 3 cm and treated with bone lengthening later on. The healing index was 33 days/cm. Time in the fixator ranged from 3 to 9,5 months. Complications including pin track infection in all cases, recurrence of infection in 2 cases.

Conclusion Traumatic septic defects in children can be managed successfully based on single stage protocol to avoid multiple stages. Osteoplastic and bony procedures can be performed concomitantly. Radical resection is not necessary is not mandatory in children.

Hip

EP-029

Total hip arthroplasty after childhood septic arthritis

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Level IV

Purpose Total hip replacement is considered one of the most successful for many hip disorders. The success rate is very high in primary cases. Patients with osteoarthritis of the hip secondary to childhood pyogenic arthritis present a special surgical challenge for total hip arthroplasty because of distinctive anatomic abnormalities that complicate total hip replacement. The aim of this study was to analyse the results of total hip replacement with cementless porous coated prosthesis after septic arthritis of the hip joints.

Methods Ten hips in 10 children age from 19 to 25 years suffering septic arthritis in infancy were followed from 50 to 130 months. Four hips were with coxa vara as a sequel to septic arthritis of the hip. All patients were treated operatively with Total Hip replacement because of painful joint degeneration. Harris hip score and limb-length discrepancy were assessed clinically. Remodelling of the femoral head, hip stability, and arthritic changes in the hip were evaluated radiographically. Only four operations were performed through a posterolateral approach. All patients were allowed to stand within 3 days and walk with partial weightbearing (40% of normal weightbearing) on crutches for 6 weeks followed by gradual return to full weightbearing.

Results At the time of last follow-up that ranged from 50 to 130 months, the Harris Hip Score (HHS) showed excellent functional outcome in three cases (30%) treated with Total Hip Replacement, good in 6 cases (60%), fair in one case (10%) and was no poor functional outcome. Trendelenburg sign become negative in all but two patients. The mean

preoperative Harris hips score of 55 points improved to 89 points at the final follow-up.

Conclusion Improved operative technique and design of cementless acetabular and femoral components provide favourable results of total hip replacement following childhood septic arthritis.

Hip

EP-030

Treatment of severe grade of slipped capital femoral epiphysis without surgical hip dislocation

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Level III

Purpose Aim of the study was to evaluate the results of treatment of acute and chronic grade III slips of SCFE.

Methods Between 1996 to 2014, 17 boys and 9 girls in age 10-16 were treated for severe slips (>60°). There were: 3 acute slips; 7 acute on chronic slips and 16 chronic stable slips. The used surgical procedures were: Dunn procedure in 15; closed reduction and fixation in 5; intertrochanteric osteotomy in 5 and fixation in situ in one. Clinical results were evaluated according to four clinical scores. The correction of angle of slip, alpha-angle and grade of arthrosis were evaluated.

Results After closed reduction, there were 80% of excellent and 20% of non-satisfactory results. The average reduction of slips was 52° and alpha angle was normal. After Dunn procedure, they were very good and good results in 40% of each, 7% of good results and 13% of non-satisfactory results. The average reduction of slip was 54° and alpha angle was in physiological range. After intertrochanteric osteotomies, there were 22% of excellent, 55% of very good and 11% of good and satisfactory results, respectively. The average correction of slip was 43° and alpha angle was over the normal range. Result of epiphyseodesis in situ was satisfactory with remodelling of the neck-head junction with abnormal alpha angle. There were 30% of hips grade I and 11% of grade III of arthrosis. Complete AVN developed in one patient after closed reduction (7%) and after Dunn procedure (7%), respectively. Segmental AVN were noted in 27% after Dunn procedure and in 20% after intertrochanteric osteotomy, respectively. There were two hip dislocations (14%) and one chondrolysis (7%) after Dunn procedure (7%).

Conclusion Surgical hip dislocation is not necessary in treatment of grade III slips because of similar serious complication.

Congenital, Syndromes, Skeletal dysplasias

EP-031

Deformity in recurvatum as a complication of guided growth for leg length discrepancy. Radiological study

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Level III

Purpose Guided growth has been used to treat leg length discrepancy (LLD), putting two plates in both sides of the femur and/or tibia. Our aim is to describe the deformity in recurvatum as a complication of guided growth in LLD.

Methods Clinical and radiological study of all patients operated on in our centre between 2009 and 2016 using guided growth with plates to treat LLD.

Results Twenty one patients (mean age 13y) underwent surgical treatment for LLD > 2 cm. In 7 patients plates were placed only in femur, in 3 patients only in tibia, and in 11 patients in both femur and tibia. In 17 patients we used two-hole plates, whereas in four patients we used four-hole plates. A significant reduction of the LLD was obtained (30mm to 15mm, $p=0.000$) with a mean correction rate of 0.6mm/moth depending on the age and the aetiology. Seven patients developed a recurvatum deformity. The mean degree was 20°. In all cases the deformity appeared in the first 6 months. There were no differences if the plates had two or four holes. X ray showed changes in the inclination of the physal line of the involved bone, femur, tibia or both. In two cases an inappropriate anterior position of the plates was noted. Computer tomography showed always that behind the plates there was a greater area of physis than ahead. That was constant in tibia due to the presence of the fibular head and of the insertion of the gracilis and semitendinous tendons.

Conclusion Iatrogenic deformity in recurvatum is a relatively frequent complication of LLD treatment using physal plates. The placement of the plates should distribute well the physal area behind and in front of the plates. This is especially difficult in tibia due to the local anatomy.

Congenital, Syndromes, Skeletal dysplasias

EP-032

Alterations of hip morphology in subjects with Down syndrome

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Level III

Purpose Hip instability in subjects with Down syndrome (DS) is common and associated with significant morbidity. The aim

of this study is to analyse the three-dimensional anatomy of the Down syndrome hip in the standing position.

Methods 41 subjects (13F, age:17.4±6.2years) with DS underwent EOS® biplanar X-rays with 3D reconstructions of their pelvis and lower limbs bilaterally in standing position. These subjects were age and gender-matched to 41 asymptomatic subjects. The following parameters were calculated: Vertical Center Edge Angle (VCE), Acetabular Abduction (AAb), Acetabular Anteversion (AAnt), Femoral Anteversion (FA) and Neck-Shaft Angle (NSA). Instability index (Iind) was calculated as the arithmetic sum of FA and AAnt. Subjects were classified according to the Tonnis and Tannast classifications of VCE, NSA, FA, AAnt and Iind. The distributions of the parameters were compared between the 2 groups using Fischer's test ($\alpha=0.05$).

Results The distributions of VCE, AAnt, FA and Iind were found to be significantly different between the two groups ($p<0.05$). Subjects with DS were found to significantly more frequently have severe overcoverage (increased VCE) compared to control subjects (39% vs. 27%). Furthermore, subjects were found to significantly more frequently have severely decreased AAnt compared to controls (28% vs. 7%). Subjects with DS more frequently had both severely increased (26% vs. 12%) and decreased (40% vs 23%) FA compared to controls. Similarly, subjects with DS were found to have hips which were both more frequently highly unstable anteriorly (13% vs. 4%) and posteriorly (34% vs. 10%).

Conclusion While most hips were found to be anatomically predisposed to posterior instability, a significant proportion of hips were found to be predisposed to anterior instability. This heterogeneity suggests that the subject-specific aetiology of hip instability should be identified in each subject with Down syndrome before determining individual treatment strategies.

Congenital, Syndromes, Skeletal dysplasias

EP-033

The use of structural allograft bone graft in extremity surgery for patients with osteogenesis imperfecta

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Level IV

Purpose Structural allograft bone plays an important role in orthopaedic surgery. It has been reported in the setting of osteogenesis imperfecta (OI) to reconstruct an extensor mechanism and as onlay bone graft to treat nonunion. Our purpose is to evaluate the utility of structural allograft bone in the setting of extremity surgery in OI patients.

Methods A single-center review of OI extremity cases from January 2002 to February 2017 was performed. Cases in which structural allograft was used were reviewed. Four categories were defined: 1) Interpositional to fill a segmental defect, 2) Onlay to provide structural support (fixed with cerclage or supplemental plate and screws), 3) Inlay to pro-

vide support in a capacious canal and/or serve as a shim, 4) Blocking to prevent rod migration. Allograft incorporation was defined as smooth bridging or loss of a distinct border for inlay allograft.

Results Structural allograft bone was used for 19 bone segments in 15 patients with severe Type III OI. The average age at time of surgery was 11.7 years (3.4-19.1). The bone segments included 8 femurs, 7 tibias, 3 humeri and 1 ulna. The usage included 4 interpositional, 3 onlay, 6 inlay and 7 blocking grafts (two uses for one bone segment). The mean time to incorporation was 5.4 months (1-16). Three complications of allograft use included a revision for proximal rod migration despite proximal blocking allograft in a tibial epiphysis, angulation of an inlay fibular strut and removal of a painful cerclage wire used with a proximal femoral onlay allograft.

Conclusion Structural allograft bone may serve as a supplement to fixation in patients with OI and incorporates into the OI bone. This review represents a classification of the usage of structural allograft bone in OI extremity surgery and provides a framework for further clinical and basic science studies.

Congenital, Syndromes, Skeletal dysplasias

EP-034

Is growth modulation effective in skeletal dysplasia?

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Level IV

Lower extremity angular deformities are common in patients with skeletal dysplasia (SKD). Growth modulation using tension band plate (TBP) for correction of angular deformities is common. This study aims to describe the use and effectiveness of this technique in the SKD population. A retrospective review of patient demographics and radiologic data was done from 2005-2017. Mechanical tibio-femoral angle, mechanical axis deviation, mechanical lateral distal femoral angle and mechanical medial proximal tibial angle measured. Groupings made based on aetiology and deformity (varus and valgus). Outcomes of the femur and tibia were assessed separately. Deformity parameters measured at the preoperative visit and at the time of hardware removal/last visit. Descriptive and univariate statistics utilized. Seventy-five patients (153 segments: 89 femurs, 64 tibia) had TBP. Analysis completed on 116 segments post TBP removal. TBP was still in place for 37 segments. Average age at surgery was 9.3 years. Gender frequency was: Femur (M:F, 44:31) and tibia (M:F, 26:15). Morquio (32) and spondylo-epiphyseal dysplasia (16) were 2 most frequent diagnoses. Ninety segments had valgus (90, (femur 60, tibia 30)). Achieved desired correction was 106/116 (91.37%). Femur and tibia recurrence of $>5^\circ$ was 28/70 (40%) and 12/36(33.33%) respectively and epiphyseal dysplasias (34/77, 44.15%) had highest frequency. Secondary TBP was 29/116. Valgus deformity had more recurrence 33/90 (36.66%) compared to 7/26 (26.92) varus. Femur complications included no correction (5) and

over correction (10). TBP for correction of angular deformities had a success rate of 91% with 38% recurrence rate of $>5^\circ$. Epiphyseal dysplasias and valgus deformity had the highest recurrence rate. TBP for correction of coronal deformities in patients with a skeletal dysplasia diagnosis has a high correction rate. Patients need to be advised to return after surgery to monitor achieved angular correction.

Neuromuscular

EP-035

Does age of surgery matter in children with cerebral palsy?

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Level II

Purpose Orthopaedic surgery in children with cerebral palsy is often deferred to an older age due to concerns of recurrence. This recommendation is justified by a hypothesis that surgery at an older age has the same results as surgery at a younger age. This study aimed to test the hypothesis.

Methods For this prospective study, we included 4- to 12-year-old diplegic cerebral palsy children, Gross Motor Function Classification System (GMFCS) levels II and III, who had similar multilevel soft tissue release for knee flexion gait. The patients were evaluated preoperatively, and at 6 weeks and 3 and 6 months postoperatively for Gross Motor Function Measure (GMFM), range of motion, spasticity and physical capacity. Children older than 10 years who were assumed to sustain gait disorder for a longer time were compared with children younger than 10 years.

Results Baseline body mass index, GMFM scores, GMFCS level, spasticity and physical capacity were comparable between younger (n = 12) and older age children (n = 8). Children with older age had greater pre-operative limitations in range of motion (44.4 vs. 36.1, $p < 0.05$) and less post-operative improvement in GMFM score (-0.3 vs. +3.0, $p < 0.05$) and physical capacity (+0 vs. +1, $p < 0.05$) than younger age children.

Conclusion The study results disprove the hypothesis that surgery at older age has the same results as surgery at younger age in children with CP. Muscle contracture was worse with growth, and deferring surgery with worsened contracture resulted in poorer surgical outcomes.

Neuromuscular

EP-036

Finding value in pelvic fixation for neuromuscular scoliosis: a comparison of the Marchesi technique to iliac screw fixation

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Level III

Purpose Scoliosis is common in neuromuscular conditions and often requires surgery with fixation to the pelvis. There are several techniques to achieve this with various biomechanical advantages. This study looks to evaluate the clinical and radiographic results of a "simpler" method of pelvic fixation (the Marchesi technique -- S1 screws with intra-iliac rod segment) and compare that to biomechanically stronger constructs (iliac screws and sacral-alar-iliac screws). Our hypothesis is that the Marchesi technique can achieve acceptable clinical and radiographic results than the stronger, and more expensive, techniques.

Methods After IRB approval, a retrospective chart review was conducted of all patients with neuromuscular scoliosis that underwent surgery with fixation to the pelvis at our institution. We looked at radiographic data and compared the results of the Marchesi group with those of the iliac screw group.

Results Data was available on 92 patients with neuromuscular scoliosis, 50 (avg. age 14.3) in the Marchesi group and 42 (avg. age 14.2) in the iliac screw group. In the Marchesi group, the final Cobb angle average was 29 degrees, representing 58% correction and average final pelvic obliquity was 8 degrees, representing 54%, compared to 30 degrees (51% correction) for final Cobb angle and a final pelvic obliquity of 11 degrees (44% correction) for the iliac screw group.

Conclusion The Marchesi method of pelvic fixation in neuromuscular scoliosis provides acceptable Cobb angle and pelvic obliquity corrections. However, the estimated cost of the iliac screw technique is greater than the Marchesi construct. Therefore, keeping in mind value (outcome over cost) in surgical treatment for this population, the Marchesi technique should be considered acceptable and possibly favourable. Significance: The Marchesi technique provides a clinically and radiographically acceptable outcome at lower cost than the biomechanically stronger iliac screw constructs.

Neuromuscular

EP-037

Brachial plexus birth palsy: refined incidence and prediction of early recovery

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Level IV

Brachial plexus birth palsy (BPBP) occurs in approximately 0.15% of livebirths, and may cause transient or permanent paralysis of the upper limb. Rates of reported early spontaneous recovery vary among studies. Some cases of limb "palsy" may be related to clavicle fracture rather than a true neurogenic

cause; furthermore, the effect of birth related parameters is uncertain (newborn dimensions, dystocia etc.). This study evaluates the incidence of BPBP in a very large cohort, and thoroughly divides clinical courses up to the age of 1 year. Among 76,000 livebirths (along 5 years), 98 (0.13%) cases of BPBP were diagnosed according to discharge report of the newborn. Structured telephone interview was used for collection of data regarding outcome during the first year of life. Outcome was obtained for 66 (67%) of cases. At 3 months of age, 51 (77%) of infants had complete recovery. At the age of one year, thirteen more infants (20%) recovered completely, and only two (3%) infants had residual longer-term neurological deficit. Clavicle fracture was the single cause of "palsy" in 20 (30%) of newborns, all had early recovery. BPBP was diagnosed in three babies born by Caesarean delivery, all had early recovery. Predictors of longer course of recovery were shoulder dystocia (according to obstetrical criteria) ($p < 0.04$), and right sided palsy ($p < 0.02$). Birth-weight, neonatal head circumference and gender were not correlated with outcome. Future reports of BPBP, should clearly differentiate between newborns/ infants showing early recovery (normal function at the age of 3 months, related to clavicle fracture or mild neuropathia), from those with true BPBP representing substantial nerve or nerve-root damage. Clear guidelines regarding newborn follow-up are part of improved diagnosis as well as appropriate early management.

Spine

EP-038

Don't you wish you had fused to the pelvis the first time: a comparison of reoperation rate and correction of pelvic obliquity

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Level II

Purpose Our objective was to compare pelvic obliquity (PO) correction and reoperation rate in neuromuscular scoliosis patients who had their pelvis included in a posterior spinal fusion (pelvic fusion, PF) at their index procedure vs revision procedures.

Methods Charts and radiographs were reviewed of patients with PF for neuromuscular scoliosis from 2003-2015 at 4 high volume paediatric spine centers with >2-year follow-up.

Results 319 patients were included; 298 had PF at index surgery and 21 had PF during revision surgery. Preoperatively, there were no differences in age at PF (index= 13.6 years, revision= 12.4 years, $p = 0.13$), Cobb angle (index= 76.7 degrees, revision= 67.8 degrees, $p = 0.15$), or PO (index= 21.2 degrees, revision= 16.2 degrees, $p = 0.08$). At the time of PF, EBL (index= 1511 ml, revision= 1205 ml, $p = 0.24$) and operative time (index = 414 min, revision= 378 min,

$p=0.32$) did not differ between groups. Correction of PO was greater for patients with index PF (49%) than revision PF (25%) ($p=0.02$). Excluding the revision surgery for inclusion of the pelvis in the revision group, there was still a lower reoperation rate with index PF (24%, $n=72/298$) than revision PF (48%, $n=10/21$) ($p=0.02$). Implant failures were higher in the revision group (index=8%, 25/298; revision=33%, 7/21; $p<0.001$).

Conclusion PF at the index spinal fusion lead to significantly greater correction of PO with approximately half the reoperation rate compared to PF at revision surgery. While we would intuitively think that extension to the pelvis is a relatively small procedure, operative time and blood loss were similar to the index procedure.

Spine

EP-039

How full body postural alignment is altered in subjects with adolescent idiopathic scoliosis?

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Level III

Purpose Subjects with Adolescent Idiopathic Scoliosis (AIS) are known to have altered spino-pelvic alignment. However, no studies have assessed their full body postural alignment. The aim was to assess full body postural alignment of subjects with AIS.

Methods 148 subjects with AIS (126F; age:14.5±2 years; Cobb:37°) and 30 control subjects (22F) underwent full body biplanar X-rays. AIS subjects were divided into 2 groups: Major Thoracic (MT:N=72) and Major Thoracolumbar/Lumbar curves (MTL:N=76). Pelvic parameters, global alignment parameters, thoracic kyphosis TK, lumbar lordosis LL, knee flexion/extension, pelvic shift, cervical spine parameters and Chin Brow Vertical Angle CBVA were measured. Differences between the control group and the 2 AIS groups were evaluated.

Results Global sagittal alignment, CBVA and lower limb parameters were similar among the three groups ($p>0.05$). TK (C:34, MT:24, MTL:29°) and C7-CSL (C:5, MT:10, MTL:13mm) were significantly different between all groups ($p<0.001$). In MT, PI and PI-LL were found to be significantly more elevated versus controls, (53 vs 45°, $p=0.02$; -5 vs -11°, $p=0.024$ resp.) as well as cSVA (9 vs 8mm, $p=0.008$). However, T1 Slope and T1-CL were significantly decreased in MT when compared to the controls (17 vs 22°, $p=0.004$; 9 vs 21°, $p=0.016$). In MTL, POb was found to be significantly more elevated compared to controls (6 vs 4mm, $p=0.017$).

Conclusion This is the first study to analyse the full body alignment in subjects with different types of scoliotic curvatures. Horizontal gaze, global sagittal alignment and lower limb

parameters were similar among the 3 groups. The MT group presented a higher PI and a thoracic hypokyphosis which lead to a compensatory increase in PI-LL to maintain their sagittal global alignment. Similarly, these subjects showed a decrease in the mismatch between T1 slope and cervical lordosis to maintain horizontal gaze. In MTL major malalignment was located in the frontal plane.

Spine

EP-040

Full body postural alignment in spastic diplegia walking with different gait patterns

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Level III

Purpose The compensation mechanism of postural alignment according to different CP gait patterns is not well known. The aim was to describe full body postural alignment in children with CP presenting different gait patterns.

Methods 26 spastic diplegia (age: 9.6±3years), age-matched to 22 TD, performed 3D gait analysis. All children performed EOS® biplanar X-rays in order to calculate knee flexion (KF), pelvic incidence (PI), sacral slope (SS), pelvic tilt (PT), sagittal vertical axis (SVA: horizontal offset from C7 plumb line to the postero-superior corner of the sacral plate), head position (CAM-HA: horizontal offset from center of the auditory canal plumb line and the middle of hip axis), thoracic kyphosis (TK), lumbar lordosis (LL), T1 and T9 tilt. Comparison between groups was performed.

Results Gait patterns for children with CP were classified as follows: apparent equinus (AE, N=9), true equinus (TE, N=9) and crouch (CR, N=8). An increased PT was present in children with AE (9.6°±9.5°, $p=0.03$) and CR (8.3°±9°, $p<0.001$) compared to TD children (4.7°±5.1°); however, the pelvis was anteverted in children with TE (-0.2°±11.6°, $p=0.01$). All children with CP presented an increased KF and an anterior shift of the head (CAM-HA) and the trunk (SVA, T1 and T9 tilt) when compared to TD. LL was decreased in crouch compared to TD (45.3°±10vs.54°±6, $p=0.002$). CR presented an increased anterior shift of the head (CAM-HA) compared to AE (49.8mm±28.7vs.17.9mm±24.6, $p=0.007$) and TE (49.8mm±28.7 vs.18mm±36.1, $p=0.004$).

Conclusion Postural alignment and compensations differ between different gait patterns in children with CP. In response to the plantar flexion, children with TE presented a pelvic anteversion compensated by knee flexion in order to displace posteriorly the center of mass. Children with crouch presented a KF with a pelvic retroversion, compensated by a hypolordosis in order to displace anteriorly the center of mass to maintain a good balance.

Spine

EP-041

The "touched vertebra" method and progression of the non-fused lumbar curve in patients with Lenke type I in AIS

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Level II

Purpose it is crucial for spinal surgery practice to define better criteria for the selection of appropriate levels to achieve a balanced spine. The purpose of this prospective randomized study was to identify risk factors for progression of non-fused lumbar curve (NFLC) according fixation level selecting "touched vertebra" method.

Methods The clinical study was carried in single institution from 2013-2016. Patients in group 1 had spine fixation below the last "touched vertebra" (LTV+1), group 2 had spine fixation above the last "touched vertebra" (LTV-1), in group 3 had spine fixation at the level of the last "touched vertebra" (LTV=LIV). Risk factors identification for NFLC progression were evaluated.

Results 73 patients were included in the study. In LTV-1 group in patients with lower skeletal maturity, LIV+1 distance was the highest among the groups in 2 years after surgery, $p = 0.005$. The LIV+1 distance in other groups, in respect of the method of fixation and skeletal maturation after 2 years, did not reach a level of significance, $p > 0.05$. ROC test and the logistic regression stepwise identified 2 factors for an NFLC progression: if skeletal maturity is Risser 0 before surgery, the OR for progression is 203.6 ($p = 0.02$), the LIV+1 distance > 12.6 mm is within 3-6 months after surgery, the OR for progression is 1,55 ($p = 0.001$).

Conclusion The biggest concern in the planning of surgical treatment for AIS should be the skeletal maturity of a patient before surgery. In the case of lower skeletal maturity of a patient, there still is a likelihood of intensive growth of the spine and progression of the non-fused curve of the lumbar spine; therefore, fixation of the spine should end at the level of the "touched vertebra".

Spine

EP-042

Long term results of pulmonary function tests after adolescent idiopathic scoliosis surgery using sublaminar bands: comparison with and without thoracoplasty

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Level IV

Purpose Aesthetic request is one of the reasons of visit for patients with adolescent idiopathic scoliosis (AIS). Several

studies demonstrated significant improvement of self-image after thoracoplasty. However, consequences of thoracoplasty on pulmonary function test (PFTs) remain controverted. Most of the studies regarding this subject involved patients who had all-screw construct surgery. Therefore, the aim of this study was to analyse thoracoplasty consequences on PFTs after surgery with hybrid construct using sublaminar bands.

Methods 97 consecutive AIS patients (Lenke 1, 2) were prospectively included between January 2014 and December 2015. All the patients underwent low dose stereoradiography images with 3D reconstructions. Surgical procedure was exactly the same in all the patients: posterior correction using posteromedial translation technic with hybrid construct (thoracic sublaminar bands and lumbar pedicle screws). Pulmonary function was explored with PFT (Forced Vital Capacity, Forced Expiratory Volume in one second and Total Lung Capacity). Radiographic parameters and PFTs were compared between patients with and without thoracoplasty preoperatively and 2 years postoperatively.

Results Mean age was 15 ± 2 years. 36 patients (37%) underwent thoracoplasty. Mean BMI was 18.8 ± 2.6 . Preoperatively, the two groups (with and without gibbectomy) were comparable for demographic data, radiographics parameters and PFT. Postoperatively, Cobb angle decreased by $32^\circ \pm 12^\circ$ and $27^\circ \pm 11^\circ$ without any significant differences between groups. At two years, PFT were similar to preoperative PFT and no difference was observed between groups. One complication due to thoracoplasty was reported (pleural effusion), which required evacuation.

Conclusion Results of the current study demonstrated that performing thoracoplasty did not worsen PFT 2 years after AIS surgery with sublaminar bands. Moreover, there was a trend for an improvement with thoracoplasty but not significant. Therefore, regarding the aesthetic benefit of thoracoplasty and the improvement of self-image scores according to literature, this procedure might be performed safely without fear of pulmonary complications, if requested.

Spine

EP-043

Optimizing the vertical position of the brace thoracic pad: apical rib or apical vertebra?

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Level II

Purpose The vertical position of the thoracic pad is a subject of controversy in brace design. Traditional recommendations dictate a maximal force applied at the level of the apical rib, about 2 levels below the apical vertebra. We sought to evaluate the optimal vertical position of the brace thoracic pad using fulcrum bending radiographs.

Methods In this prospective study, we recruited patients presenting with adolescent idiopathic scoliosis and Risser stage 0-2 over a period of 12 months. Patients with a history of spine or thoracic surgery were excluded. Two fulcrum bending radiographs were performed for each patient: one with the center of the fulcrum placed under the most lateral part of the apical rib and another with the fulcrum centered below the apical vertebra. Cobb angles were measured on each fulcrum radiograph and compared using a paired t test.

Results Fifty-two patients were included, with a mean age of 12.4 years and mean thoracic Cobb angle of 37.5°. Placing a fulcrum under the apical vertebra reduced the Cobb angle to a mean of 11.5°, which was significantly lower than a fulcrum placed under the apical rib (14.3°, $p=0.001$). This corresponded to a 20% loss in correction when placing the fulcrum under the apical rib. The difference between the 2 Cobb angles was not significantly correlated to patient age ($p=0.896$) or curve apex ($p=0.555$).

Conclusion This is the first clinical study addressing the vertical position of the thoracic pad in braces for AIS. A lateral force applied at the level of the apical vertebra was significantly more efficient at reducing thoracic curve deformities than one applied at the apical rib. Our results provide clinical support for finite element studies that refute traditional recommendations of brace design, advocating for a revision of these guidelines to optimize non-operative treatment of AIS.

Spine

EP-044

Evaluation of spine sagittal balance in children with achondroplasia in lower limbs lengthening using Ilizarov method

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Level III

Purpose Spinal canal stenosis and sagittal disbalance are the most frequent changes in spine in achondroplastic patients (Hong J.-Y., 2011, Kolesov S.V., 2013, Misra S.N., 2013). Transosseous osteosynthesis allows to lengthen lower limbs for 28-30 cm. The question is if lengthening influences on spine condition. We planned to study sagittal balance at different stages of limbs lengthening.

Methods We performed cross-sectional clinical-radiological study of 26 patients with achondroplasia before treatment and at different stages of limbs lengthening. Limb lengthening was performed using stage by stage technique of distraction osteosynthesis. We evaluated sagittal balance of spine and pelvis radiologically. Clinical evaluation was performed basing on examination, neurological status and pain scale.

Results Clinical evidence of sagittal disbalance was hypokyphosis of thoracic spine in 100% of cases and lumbar spine lordosis increase in 57,6% of patients. Neurological disorders were not diagnosed. Pain syndrome was in 15,3% of

cases rating from 2-4 scores. After stage by stage lower limbs lengthening for 15,3±5,0 cm we observed change of sagittal vertical axis of trunk, lumbar lordosis index decrease, increase of pelvis index, pelvis and sacrum inclination angle.

Conclusion Lower limbs lengthening with Ilizarov methods improved parameters of sagittal balance up to healthy peers which is connected with high correlation dependence of number of lower limbs lengthening and pelvic coefficients.

Spine

EP-045

Combined use of navigation (NAV) and triggered EMG for the safe placement of thoracic pedicle screws (TPS)

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Level II

Purpose The use of t-EMG potentials (t-EMGP) stimulation for TPS monitoring has been unable to establish a clear-cut value while NAV offers an alternative but at a cost of high radiation doses and prolonged surgical time. The goal was to assess if the combined use of NAV and t-EMG may decrease the radiation dose and surgical time in AIS (Adolescent Idiopathic Scoliosis) patients.

Methods 329 TPS were implanted by free hand technique in 20 patients with main thoracic AIS. Whenever difficulties were found with implantation screw was skipped and placed under NAV. At the end of TPS placement was checked with screw t-EMGPs and a CT-scan was obtained of the whole instrumented spine. For those TPS with t-EMGP ≤ 7 mA, the screw was removed and probed, if no breach was detected and CT determined a correct placement the screw was left in place.

Results Twenty screws had a t-EMGP ≤ 7 mA, the intraoperative CT-scan revealed that 11 of them were inside the pedicle, and had a normal tract feeling. The remainder 9 had a breach either medial (7) or inferior (2). The prediction chance of a t-EMGP ≤ 7mA to detect a breach was higher for screws around the apex (T7-T9) (6/10 presented a breach). Additionally, 19 TPS with a threshold between 8-9mA were analysed, only 4 presented a breach either medial (3) or inferior (1). The predictive value of a t-EMGP ≤ 7 mA for medial or inferior placement was only of 45%, while for t-EMGPs < 10 mA was only of 38,5%. When only TPS around the apex were analysed the positive predictive value for a t-EMGP ≤ 7mA increased to 60%.

Conclusion In our hands the reliability of t-EMGPs was not high enough to skip the use of CT-scan to ascertain the placement of the TPS.

Spine

EP-046

Incidence and description of scoliotic curves in Friedreich ataxia at skeletal maturity

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Level II

Purpose Friedreich ataxia (FA) is a spinocerebellar degenerative disorder associated to several orthopaedic deformities such as scoliosis. Studies focusing on scoliotic curves in FA patients at skeletal maturity are rare. A trend toward as-late-as possible corrective spinal surgery is observed given the concern of potential postoperative loss of walking ability. The aim was to describe the progression and characteristics of spinal shapes in a paediatric cohort of FA patients.

Methods Sixty-eight FA patients were included prospectively between 2008 and 2016. Clinical and radiological (full-spine biplanar stereoradiography) records were conducted twice a year. Coronal curve type, segmental measurements and the Risser sign were assessed.

Results Mean follow-up was 5 ± 2.3 years. Scoliosis was noted for 51 patients and 28 (14F/14M) were at skeletal maturity (Risser Index > 4). Mean age at scoliosis diagnosis was 12.7 ± 2.5 yrs and did not differ from FA molecular diagnosis (12.6 ± 3.2 yrs). Thoracic main curve was present in 12 patients (43%) with a Cobb angle of $34^\circ \pm 15.5^\circ$. Nine patients (32%) presented with a double major curve with a Cobb angle of $41^\circ \pm 11.4^\circ$. A lumbar curve was noted in 7 (25%) with a Cobb angle of $27^\circ \pm 17.8^\circ$. Hyperkyphosis (T1-T12 sagittal Cobb angle > 50°) was present in 12 patients (44%) essentially in the main lumbar scoliosis group. Eight patients underwent a posterior spinal fusion, including 5 non-ambulant and 4 ambulant (44%) patients. Latter kept an autonomous walk at least 1 year after surgery.

Conclusion The prevalence of scoliosis was high (75%) and all types of curves were present. Thoracic hyperkyphosis was frequently encountered and might reflect the anterior imbalance characteristic of cerebellar gait. Loss of an autonomous walk in FA scoliotic patients is not associated with spinal surgery.

Spine

EP-047

Size matters: Which adolescent patients are most likely to require surgical decompression for lumbar disk herniation?

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Level III

Purpose Lumbar disk herniation occurs infrequently in the paediatric/adolescent population. A minority of patients with radicular symptoms fail to improve with conservative management and require discectomy. The authors hypothesize

that children who ultimately require surgical intervention have an underlying congenital lumbar stenosis.

Methods A retrospective chart review was performed at a tertiary paediatric orthopaedic institution. Paediatric patients with lumbar disk herniation and MRIs available for electronic review were identified. Patients with spondylolisthesis, fractures, previous spine surgery, or structural thoracolumbar scoliosis were excluded. Demographic and surgical details were collected. On T2 weighed MRIs, measurements were taken of the L4 and L5 vertebral body diameters (VBD) and canal diameters (CD). Statistical analysis was performed using two sample T-test for continuous variables, and ROC curves were generated to identify possible thresholds.

Results 76 patients (37 males, 39 females) were identified with a lumbar disk herniation from 2001-2016. 11 patients required discectomy. 65 patients were managed conservatively. Average age at MRI was not different between groups (15.1 ± 1.7 vs 14.9 ± 2.2 years, $p=0.82$). VBD at L4 and L5 were not different between groups ($p=0.2$ and $p=0.36$, respectively). There was significant stenosis in the surgically treated cohort at L4 (11.6 ± 1.6 mm vs 14.2 ± 2.1 mm, $p=0.0002$) and at L5 (10.1 ± 1.3 mm vs 14.2 ± 2.2 mm, $p<0.00001$). The ratio of CD:VBD was significantly lower in the surgically treated group at L4 (0.36 ± 0.06 vs 0.46 ± 0.08 , $p=0.0002$) and L5 (0.31 ± 0.68 vs 0.45 ± 0.08 , $p<0.00001$). Patients with a L4 CD<12.6mm were 18.8X more likely to require surgical decompression compared to patients with a larger CD. 100% of patients with a L5 CD<12.36mm ultimately required surgical decompression.

Conclusion Adolescent patients with congenital lumbar stenosis that develop a lumbar disk herniation are significantly more likely to require surgical decompression to relieve persistent radicular symptoms. A L4 CD<12.6mm and a L5 CD<12.36mm were highly correlated with the need for decompression.

DDH

EP-049

The role of the labrum in early treatment of unstable DDH

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Level II

Purpose Aim of this retrospective study was to verify the morphological changes and role of the labrum in unstable DDH during early treatment.

Methods Between January 2013 and December 2015, data was collected of 60 (52F; 8M) patients (age range: 1 day -- 134 days; average: 53 days) previously treated for unstable DDH. The US examination was performed according to

Graf's technique. We collected 86 dysplastic hips (32 mono-lateral; 27 bilateral), divided in: type D (n = 13), type III (n = 49) and type IV (n = 24). The labrum was evaluated for echogenicity and dimensions; an inter- and intra-observer test (4 health workers) was conducted on US images. Tests were: TEST 1 (comparison of the labrum in US image at DDH diagnosis and a randomly chosen US image); TEST 2 (comparison of the labrum in US image at DDH diagnosis and US image of the same patient at the end of treatment). Statistical analysis was performed using Cohen's and Fleiss' coefficient.

Results Test 1 showed very good concordance for echogenicity and dimensions (k 0,81 -- 1); Test 2 showed very good concordance for echogenicity and very good/good concordance for dimensions (k 0,61 -- 1). The labrum was less echogenic in Test 1 (79% of observers' answers), more echogenic (97%) in Test 2. The labrum's dimensions were smaller in Test 1 (80%), larger in Test 2 (96%).

Conclusion In Test 2 where we compared the labrum at the moment of unstable DDH diagnosis and in the same patient at the end of treatment, there was a strong statistical concordance, meaning the labrum undergoes morphological modifications. During early treatment of unstable DDH the labrum presented an increase of fibrous tissue (echogenicity) and size (morphology), and acts as an active stabilizer of the femoral head.

DDH

EP-050

Screening for developmental dysplasia of the hip: discrepancies in outcome between hip ultrasounds and pelvic x-rays. Comparing outcomes of hip ultrasounds with pelvic x-rays for screening for DDH in a large teaching hospital in the Netherlands

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Level II

Purpose Originally in our hospital, pelvic x-rays were used for screening patients for developmental dysplasia of the hip (DDH). In 2015 we started to use hip ultrasounds for screening for DDH. In order to maintain quality of screening, we used both hip ultrasounds and pelvic x-rays during the purpose of this altered imaging. The aim of our study was to investigate if there was a discrepancy between the outcome of hip ultrasounds and pelvic x-rays in patients with risk factors for DDH.

Methods All children with known risk factors for DDH or abnormalities at physical examination of the hip, were screened for DDH with ultrasounds of the hip by using the Graf classification. When this ultrasound demonstrated DDH of one or both hips, an additional pelvic x-ray was performed. When there was uncertainty on the diagnosis based on the

hip ultrasound we performed additional x-rays as well. Pelvic x-rays were classified with AC indexes according to Tönnis, and were screened for the presence of non-centred hips or interruption of Shenton's lines.

Results Between April 2015 and February 2017, 1054 patients were screened for DDH in our hospital. 96 dysplastic hips in 87 patients were diagnosed by hip ultrasounds. These 87 patients received additional pelvic x-rays. Additional pelvic x-rays of 52 other patients were performed as well. 37 of the 96 (38.5%) dysplastic hips diagnosed by hip ultrasound demonstrated no signs of DDH on additional pelvic x-rays. Furthermore, additional 10 dysplastic hips were diagnosed on pelvic x-rays while ultrasound of the hip did not show signs of DDH.

Conclusion Comparing the results of screening for DDH by hip ultrasounds with pelvic x-rays demonstrated a discrepancy in outcome. 38.5% of the dysplastic hips diagnosed by hip ultrasound demonstrated no signs of DDH on additional pelvic x-rays.

Hip

EP-051

Femoral derotation osteotomy: is IM fixation superior to plate fixation?

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Level III

Purpose Femoral derotational osteotomy (FDO) is a preferred treatment for excessive femoral anteversion or retroversion. Our review compares outcomes of two implants, intramedullary (IM) nail and plate fixation (PF). Advocates of plate fixation like the rigid fixation and stability in spite of large incisions, postop immobilization and subsequent hardware removals. IM nails might be advantageous due to small incisions, earlier postop ambulation and no need for removal. It is our hypothesis that IM fixation provides better outcome for children undergoing FDO.

Methods A retrospective study comparing outcomes for FDOs using IM nails and plate fixation was performed after local IRB approval. All patients who underwent FDO between 1/1/2005 and 7/11/2016 at our facility were grouped by IM nail fixation or PF. Surgical time, estimated blood loss, weightbearing status and date of radiographic healing were compared. Standard lateral approach, with open proximal peritrochanteric femoral osteotomy, was used for PF. Lateral or standard trochanteric approach was used for IM fixation, with percutaneous femoral isthmus osteotomy. Derotation pins corrected rotation. One incision was used for PF cases, and four small incisions for IM cases. Postoperatively, PF patients were non-weightbearing for 6-8 weeks whereas IM patients were full weightbearing immediately.

Results Twenty-seven patients underwent FDO. Sixteen had IM nail fixation at average 15.8 years old and eleven had PF at average 13.7 years old. Subsequent hardware removal

was required for 100% of PF cases and 0% of IM cases. Fifteen of the 16 patients in Group IM were able to weight-bear by POD3. Group PF were able to weight-bear in 32-73 days.

Conclusion No significant difference in surgical time, blood loss or radiographic healing was found between the two groups. Although not statistically supported, weightbearing status was observed as favourable in the IM group and may signify better outcomes.

Foot

EP-052

The influence of flat talus deformity on ankle mobility in children in middle childhood with clubfoot

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Level III

Purpose Clinical relevance of flat talus deformity has rarely been described in literature. The aim of this study was to evaluate talus deformation and its correlation with type of treatment, physical exam, kinematics, kinetics and outcome questionnaires in children with clubfoot in middle childhood (6-12 years old).

Methods Group 1: 31 children treated with posterior release. Group 2: 22 patients treated with the Ponseti method. Group 3: 25 control subjects. Weight-bearing radiographs were obtained and flat talus presence was assessed by a radiologist who was blinded to the patients' treatment. A ratio was designed (height of dome/ length of talus) to characterize: absence or presence of flat talus. Physical examination on ankle range of motion was performed. An 8-camera Kinescan system (IBV) was used for gait analysis. Functional ANOVA was implemented to analyse wave forms of kinematic and kinetic data.

Results Flat talus was present in 48.1% of patients with Ponseti versus 47.5% posterior surgical release, $p=.958$. Physical exam showed no differences in ankle range of motion (dorsal and plantar flexion) between treatment groups and flat talus deformity. Global PODCI score showed no differences between treatment groups and presence of flat talus, $p=.131$. Functional data analysis (FDA) of ankle sagittal plane kinematics revealed that Ponseti method with flat talus deformity showed more similar resemblance to control group kinematics than posterior release. FDA of kinetic data demonstrated that Ponseti group with flat talus had greater braking force than posterior release.

Conclusion Flat talus deformity appears to be an idiopathic condition independent of treatment. Range of motion and force generation at the ankle joint is not severely limited by this deformity although patients treated with Ponseti method and presence of flat talus appear to have trends toward better results than those who have had surgical treatment and flat talus.

Hip

EP-053

Childhood obesity and failure of the proximal femoral physis: a nationwide population-based cohort of children demonstrating evidence for causality between childhood obesity and slipped capital femoral epiphysis

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Level I

Purpose There is an epidemic of childhood obesity, which is growing at an alarming rate. There is considerable focus on long-term associations with childhood obesity, yet an important short-term disease association can cause profound lifelong disability; Slipped Capital Femoral Epiphysis (SCFE). Whilst SCFE is the most common hip disease in adolescence, little is known of the strength of the obesity association with suggestion that it may be causal.

Methods We investigated the association with body-mass index (BMI) at school entry (mean age 5.5 years), and the subsequent development of SCFE in adolescence (6 to 18 years old) using a nationwide cohort of Scottish schoolchildren from whom height and weight was routinely recorded at school entry. The Scottish Morbidity Record was linked to identify cases of SCFE.

Results There were 4.26 million child-years (6 to 18 years) of surveillance amongst 597,017 individuals, of whom 209 children had a diagnosis of SCFE. There was a strong biological-gradient linking BMI and SCFE with the risk of disease increasing by 1.7 times (95% CI 1.5 to 1.9; $p<0.001$) for each integer increase in z-score of BMI. There were no diagnostic entries of SCFE for those with a z-score for BMI of <-3 at entry into the cohort. The risk of SCFE amongst those with a z-score of BMI >3 was 15.7 times greater z-score of BMI between -3 and -2.

Conclusion Higher BMI at school entry is strongly associated with increased risk of SCFE in childhood. The magnitude of the association, the temporal relationship and the dose-response, added to a plausibility pathological process and consistency with prior low-quality evidence, offer strong support for a causal relationship. Given the childhood obesity epidemic, clinicians need to be especially alert that SCFE is a severe physical consequence of obesity in childhood. We provide the most robust possible evidence to support a causal association between childhood obesity and Slipped Capital Femoral Epiphysis (SCFE).

Trauma

EP-054

Long-term outcomes following mid-shaft clavicle fractures in adolescents: Does internal fixation improve outcomes?

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Level II

Purpose Mid-shaft clavicle fractures are common in adolescents. There is an increasing body of literature supporting operative management of clavicle fractures in adults, but few studies guide management in adolescents. This study aims to compare functional and quality of life outcomes in adolescent patients with mid-shaft clavicle fractures treated operatively and non-operatively.

Methods Adolescent patients with mid-shaft clavicle fractures treated between 2006-2014 were identified from an institutional database. Patients aged 10-18 with closed fractures and one-ten years post-treatment were included. Eligible patients were analysed by treatment operative vs non-operative and contacted for follow-up. Outcomes of interest included the QuickDASH, UCLA Activity Scale, PROMIS Pain Interference and Upper Extremity, HSS Paediatric Functional Activity Brief Scale (Pedi-FABS), and Visual Analog Scale (VAS). Descriptive and univariate statistical analyses were performed.

Results 275 patients were included. Approximately half were treated operatively, and 3% underwent hardware removal. The mean age at time of injury was 16.2 years for operative and 13.4 for non-operative patients. The re-fracture rate was 4% in the operative group and 1% in the non-operative group. There were no non-unions. The mean scores for operative and non-operative patients, respectively, were as follows: QuickDASH 4.0 and 2.1 ($p = 0.03$), UCLA Activity Score 9.2 and 9.1 ($p = 0.01$), PROMIS Pain Interference 32.2 and 32.2, PROMIS Upper Extremity 57.2 and 57.2, Pedi-FABS 19.3 and 18.2 ($p = 0.04$), and best VAS 0.2 and 0.2 ($p = 0.18$).

Conclusion Displaced mid-shaft clavicle fractures in adolescents have excellent outcomes when treated both non-operatively and operatively. Operative management showed similar functional outcomes to non-operative treatment, but was associated with a greater refracture rate, and 4% required secondary surgery for implant removal.

Trauma

EP-055

Health-related quality of life after fractures of the lateral third of the clavicle in children and adolescents. Preliminary results from the Bernese paediatric fracture project

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Level IV

Purpose The health-related quality of life after paediatric fractures of the lateral third of the clavicle is unknown. We

examined the health-related quality of life (HRQoL) of patients who sustained a fracture of the lateral third of the clavicle in childhood of a large regional paediatric trauma center, if fracture and dislocation patterns were associated with HRQoL, and if the HRQoL was associated with the age at the time of the injury.

Methods We identified 69 patients (21 girls) who sustained a fracture of the lateral third of the clavicle from January 2004 to June 2015. These patients were asked to answer the PedsQL (Paediatric Quality of Life Inventory) and the Quick version of the DASH (Disability of Arm, Shoulder, and Hand). Until July 2017 we were able to get a response of 56 of these patients, resulting in a follow-up of 81%.

Results Although these fractures occurred in all age groups, girls were significantly younger than boys at the time of injury (4.6 vs. 8.0 years), which could be attributed to different distributions in age groups. Treatment was conservative in all cases but one. After a mean follow-up of 6.5 years (range 1.0 to 13.2 years) the mean Quick-DASH was 1.3 (SD 4.4) at a scale of 0-100, with lower values representing better HRQoL. The mean Physical Health Summary Score of the PedsQL was 97.8 (SD 4.4) at a scale of 0-100, with higher values representing better HRQoL. There were no statistically significant associations between fracture or dislocation patterns with regard to HRQoL.

Conclusion Conservative treatment fracture of lateral clavicle fractures in children and adolescents is associated with excellent HRQoL as measured with the Quick-DASH and the PedsQL. It is unlikely that these results could be further improved by surgical interventions.

Trauma

EP-056

Elastic stable intra-medullary nailing for radial neck fracture in children: can a lack of correction be tolerated? Outcomes at skeletal maturity

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Level IV

Purpose Elastic stable intra-medullary nailing (ESIN) is the treatment of choice in children radial neck fractures. When the fracture is not completely reduced by the bended nail, percutaneous pinning and open reduction can be performed to complete the reduction. Both techniques expose to the risk of radial nerve palsy and radial head necrosis. The aims of the study were to analyse functional and radiological outcomes at skeletal maturity and assess if a lack of correction is acceptable.

Methods Between 2005 and 2016, patients operated on a radial neck fracture were retrospectively reviewed at skeletal maturity. Metaizeau classification was used to describe fractures displacement (Grade 1 < 20°, Grade 2, Grade 4 > 80°). Grade 1 fractures were not surgically treated. Functional assessment used the Mayo Elbow Performance Index (MEPI)

and the QuickDash (QD). Full upper-limb radiographs were performed for radiological outcomes.

Results Forty-nine patients were included. Twenty grade 2, 22 grade 3 and 7 grade 4 fractures were operated at mean age of 9 years. ESIN was performed in 19 cases, complementary percutaneous pinning was required in 21 cases and open reduction in 9 cases. At mean follow-up of 5 years, functional scores were excellent except in one patient, for whom an open reduction was performed (Grade 4). Persisting radial head tilt of 20° to 25° and > 25° was found in respectively 21.7% and 25% on first postoperative radiographs. At last follow-up, radial head tilt was < 20° for all the patients except one. Revision surgery was required for this patient because of an osteonecrosis.

Conclusion ESIN remains the treatment of choice in radial neck fractures with excellent functional results at skeletal maturity. Persisting displacement can be tolerated, because of bone capacity to remodel with growth.

Trauma

EP-057

Axial alignment deformity in Cozen's fractures in children. Long-term results

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Level IV

Purpose We report the axial alignment deformity, in particular valgus deformity, as well as residual limb length discrepancy in Cozen's proximal metaphyseal tibial fractures in children, after long-term follow up. Cozen's phenomenon is described as the late-onset post-traumatic valgus deformity associated with proximal tibial metaphyseal fractures in children.

Methods 30 patients with Cozen's fractures were followed up. 27 of these were managed conservatively, whereas 3 were treated surgically. Mean age of children at time of fracture was 7 years (range 1-14). 17 of the children were under 7, while the remainder 13 were between 7 and 14. Mean follow up was 9,5 years (range 5-27).

Results Valgus deformity was noted in 73% of patients under 7, as well as 17% of those between 7 and 14. The maximum deformity ranged from 8° to 18° and was noted between 10 and 18 months post traumatically, mostly in younger patients and after inadequate reduction. In all cases there was correction of the valgus deformity with a residual deformity ranging from 1° to 9°. Elongation of the fractured limb was noted in 74% of patients and ranged between 0.4cm and 1,5 cm, irrelevant of age. There was a compartment syndrome complication in one case.

Conclusion The majority of patients under 7 years old, developed valgus deformity following a proximal tibial metaphyseal fracture. This was irrelevant of initial displacement and

whether the patient was treated surgically or conservatively. At 2 years post injury, we noted progressive spontaneous correction of the deformity. We conclude that in Cozen's type fractures in children, surgical treatment can usually be avoided. Long term follow-up is warranted in order to recognize axial alignment deformity and also establish the existence of spontaneous correction.

Trauma

EP-058

Nursemaid's elbow: supination-flexion technique vs. hyperpronation/forced pronation. Randomized clinical study

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Level III

Purpose Nursemaid's elbow or radial head subluxation represents the most common paediatric pathology met in paediatric orthopaedic ambulatory under the age of 6, representing about 20% of upper extremity conditions. The study aims to compare between supination-flexion method and the hyperpronation/forced pronation for reducing the radial head subluxation and to measure the degree of patients' discomfort.

Methods The study included patients under 7 years old that were diagnosed with Nursemaid's elbow. We chose to conduct a prospective randomized controlled study, unblinded, interventional. The patients were randomized. Every odd numbered patient received the supination-flexion technique, while the even numbered patient received the hyperpronation technique. Reevaluation was done every 10 minutes. The initial procedure was repeated if the first attempt failed. If the second attempt failed, it resulted in a crossover to the alternate method for the third attempt. If the patient failed both techniques, plain x-ray of the elbow was performed. Pain evaluation was done using the Visual Analogue Scale, after the reduction. Data was analysed using SPSS 18.0.

Results From 155 patients, 116 were selected for the study. The supination-flexion was applied to 42 patients, while the hyperpronation was applied to 72 patients. 2 patients underwent a cast treatment for 1 week. Using the Visual Analogue Scale, we noticed an average score of 5,9 for supination-flexion technique, while the hyperpronation technique achieved 5,3. The results were not statistically significant.

Conclusion Hyperpronation was found more successful ($p < 0.001$) than supination-flexion technique as a first attempt (85% vs. 53%), second attempt (50% vs. 28%) and as a crossover technique (100% vs 50%) when supination-flexion failed. Even if the pain scores are not statistically significant, in our personal opinion, hyperpronation was less painful for the patient, but further studies should be done comparing same age patients.

Trauma

EP-059

Long-term outcomes following distal clavicle fractures in adolescents: Does internal fixation improve outcomes?

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Level II

Purpose Distal clavicle fractures are uncommon. There are few studies focusing on the management and outcomes of these injuries in adolescents. The purpose of this study was to compare functional, radiographic, and quality of life outcomes in adolescent patients with distal-third clavicle fractures that were treated with or without surgery.

Methods An institutional database search identified adolescent patients with distal-third clavicle fractures treated between 2006-2014. Patients aged 10-18 with closed fractures and one-ten years post-treatment were included. Patients were analysed by treatment operative vs. non-operative groups and contacted for follow-up. Outcomes of interest included the QuickDASH, UCLA Activity Scale, PROMIS Pain Interference and Upper Extremity, HSS Paediatric Functional Activity Brief Scale (Pedi-FABS), and Visual Analog Scale (VAS). Complications were assessed through chart review and follow-up. Descriptive and univariate statistical analyses were performed.

Results 52 patients were included; 34 treated operatively and 18 treated non-operatively. The mean ages at time of injury in the operative and non-operative groups were 14 and 15 years respectively. Approximately 6% of patients in the operative group underwent hardware removal, with no re-fractures in either group. Mean time to follow-up was 2.9 years for the operative group and 1.5 years for the non-operative group. Mean scores for operative and non-operative patients, respectively, were as follows: QuickDASH 4.0 and 6.1, UCLA Activity 9.0 and 8.7, PROMIS Pain Interference 44.0 and 42.8, PROMIS Upper Extremity 53.3 and 49, Pedi-FABS 16.3 and 20, and best VAS was 0 for both (non-significant).

Conclusion Distal clavicle fractures have excellent outcomes treated both operatively and non-operatively. There was no significant functional benefit to operative management, and it was associated with a small degree of secondary surgery for implant removal. This study is limited by its retrospective nature; the treatment groups were not identical at baseline.

Trauma

EP-060

Open reduction and internal fixation of displaced lateral humeral condyle fractures in children

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Level IV

Fracture of the lateral condyle of the humerus is the second most common fracture about the elbow in children. Displaced fractures require appropriate reduction and stabilisation. There are, however, a number of controversies in management of these patients. The aim of this study was to evaluate treatment of these fractures retrospectively and explain the relationship between the injury pattern, the subsequent therapy and both functional and radiological outcome. We retrospectively reviewed children treated with ORIF of lateral humeral condyle fractures over a period of 10 years. Case notes and radiographs were reviewed. Final functional outcome was evaluated as proposed by Hardacre. 70 lateral fractures were identified in 45 male and 25 female patients. Average age was 6.5 years. According to Jakob's classification, 25 were stage II and 45 stage III. In 6 cases, accompanying elbow injuries were reported. Average follow-up was 7.5 months (12 weeks - 7.5 years). 61 patients were treated directly. In 42 cases K-wires were left above the skin and in 28 cases were left beneath the skin. In all cases union was achieved. Neither cases of premature physeal closure or osteonecrosis were observed. The most common complication was lateral spur formation noted in 67 patients. Functional evaluation revealed: 56 excellent results (80%), among whom an anatomical reposition was obtained in 82% cases and 12 good results among whom an anatomical reposition was obtained in 50% cases. The outcome of 2 patients was rated as poor. An open (anatomical) reduction and internal fixation using K-wires gives a very good result. In the case of concomitant elbow injury, the worse outcome should be expected. Slight delay in surgical treatment does not affect the final outcome. Implant removal about month after surgery does not increase risk of redisplacement. Leaving K-wires above the skin does not increase risk of complications.

Trauma

EP-061

Distal radial fractures in children: risk factors for redisplacement following closed reduction

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Level IV

Distal radial fractures are among the most common injuries in children, with the majority treated by closed reduction and cast. The aim of this study was to assess the significance of the many factors in redisplacement after closed reduction and immobilization. This retrospective study included 108 displaced distal radial fractures. 51 fractures were physeal and 57 metaphyseal. Mean age of patient was 7.3 years. Location of fracture, initial displacement, an associated ulna fracture, grade of surgeon and accuracy of reduction were measured for assessment as potential risk factors. In addition, 3-point index was measured to assess quality of plaster application.

The quality of reduction and redisplacement were classified according to criteria described by Almedaroglu. The mean observation time was 35.3 days. Of the 108 fractures, there were 24 redisplacement of fractures. 5 physeal (were 80% anatomical reductions was achieved) and 19 metaphyseal (32% anatomical reductions). The median interval to loss of position was 8 days. In the group without redisplacement, 66 fractures had bone contact and 18 fractures had no contact. In the group with redisplacement, 12 fractures had bone contact and 12 fractures had no contact. Associated ulna fracture were observed in 31 patients. 9 of these were found in the group with redisplacement. Anatomic reduction was achieved in 83 fractures and in 25 patients reduction was non-anatomical. The overall median 3-point index was 1.17. In the group of physeal fractures, the index was 0.96 and 1.03 for non-displaced and displaced fractures, respectively. In the group of metaphyseal fractures, the index was 1.32 and 1.44 for non-displaced and displaced fractures, respectively. Metaphyseal, completely displaced distal radial fractures that cannot be anatomically reduced have a higher risk of redisplacement following closed reduction. In addition, associated ulnar fracture, quality of cast application and the surgeon's experience play an important role.

Trauma

EP-062

Consequences following distal femoral growth plate violation with an intramedullary implant: a pilot study in an ovine model

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Level II

Purpose Distal femur fractures in paediatric patients represent a challenging treatment entity in resource poor countries, due to the lack of advanced operating room equipment and appropriate implants. Insertion of a retrograde femoral nail is a practical solution but involves violating the open distal femoral growth plate. The literature is unclear about the tolerance for putting a large diameter metal implant across the physis. The purpose of this investigation was to define the upper limit of cross sectional violation with a metal implant before causing premature growth arrest using a sheep model.

Methods A total of 18 sheep underwent placement of a retrograde, intramedullary implant at 3-months of age through an open distal femoral growth plate. The cross-sectional area of the distal femoral physis was measured pre-operatively and implants were selected that violated 3% to 8% of the cross-sectional area of the growth plate at 1% intervals (n=3 sheep at each interval). Growth across the distal femoral growth plate was examined radiographically at 4 weeks, 8 weeks and following euthanasia 10-weeks following surgery. Following euthanasia, both the operative and non-operative contralateral femurs were removed and dissected to

compare differences in maximal femoral lengths using digital calipers.

Results Radiographic measurements of growth across the distal femoral physis demonstrated that growth continued in all specimens post-operatively. When compared to control limbs, only operative limbs with 8% of cross-sectional physeal violation demonstrated a true growth arrest.

Conclusion Distal femoral growth continues across the physis when 3% to 7% of the cross-sectional area of the physis is violated using a retrograde intramedullary implant. Specimens with 8% of growth violation demonstrated significant growth arrest. Retrograde femoral nailing may be a viable option in the treatment of paediatric distal femoral shaft fractures in resource poor countries where other options are limited.

Trauma

EP-063

Cortical bone disruption after elastic stable intramedullary nail fixation for paediatric long bone fracture

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Level IV

Purpose Elastic stable intramedullary nail (ESIN) is widely used for the treatment of long bone fractures in children. We identified cortical bone disruption in some children with long-standing nail retention and reviewed this complication in our database.

Methods 221 children (223 fractures) who kept the elastic intramedullary nail fixation for more than 6 months were included. Two paediatric orthopaedic surgeons reviewed eccentric migration of the IM nail or penetration of the cortex by the IM nail.

Results Penetration of nails through the cortex of the bone on follow-up radiographs was found in 26 cases (11.7%). Ten cases (4.5%) showed a protrusion of the sharp tip of the IM nail at the metaphysis-diaphysis junction. Sixteen cases (7.2%) showed cortical disruption at the diaphysis.

Conclusion Cortical bone penetration by ESIN was an unreported complication in children. The expected problem related to this complication should be considered for children who maintain ESIN for a long period.

Trauma

EP-064

Removal of elastic nail in children

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Level IV

Purpose Elastic intramedullary nailing technique is the gold standard treatment for diaphyseal upper and lower limb fractures in children when operative stabilization is required. Many authors showed the benefits of this procedure, especially for early mobilization and functional activity. But there is not a lot of information in literature about an important aspect of the technique: the removal of nails after the healing time.

Methods The study was a retrospective analysis of 70 patients treated with intramedullary nailing. Studied data were: age, sex, number of days in hospitalisation, technical difficulties while surgery, operating time, kind of anaesthesia, postoperative immobilization (when applied), sports eviction duration, compliance. Three different functional scores were used to assess clinical recovery.

Results Authors evaluated 70 patients (51 males; 19 females) operated from 2011 to 2016. Mean age was 10,5 years old. Operative treatment concerned 38 forearms (16 right; 22 left), 13 humerus (9 right; 4 left), 12 femurs (6 right; 6 left), 7 tibia (4 right; 3 left). Kind of anaesthesia used for hardware removal was mainly locoregional anaesthesia (peripheral nerve blocs) and mean time for surgery was 37 ± 18.9 minutes. Mean time between primary surgery and hardware removal was 9 ± 4.4 months. Full normal daily living activity was possible one week after hardware removal, even if patients were advised to avoid sportive activities for $23,7 \pm 14,2$ days. Hardware removal was easy in most cases with 2 post-operative major complications (re-fracture and tendon rupture) and 3 minor complications.

Conclusion In this study, we wanted to show that elastic nail removal is an essential step of the intramedullary nailing technique. It is often underestimated both concerning possible technical difficulties and complications of surgery and concerning the impact on the patient and his family.

Trauma

EP-065

Trends in the epidemiology of paediatric fractures

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Level II

Purpose It is known that the incidence of paediatric fractures varies throughout the year and peaks during the summer. Changes in behaviour patterns of children have led to a suspicion that this variation has changed. Having an updated analysis of the current epidemiology and its seasonal variations can assist in re-evaluating prevention plans, planning medical workforce and further understanding children's behaviour.

Methods A retrospective record review of all patients between the ages of 0-16 that were diagnosed with fractures in the ER of a level 1 orthopaedic trauma center was conducted. The fractures were stratified according to patients' variants, the

injury locations, and the hour, day and month with respect to holidays, weekends and weather.

Results 3263 fractures were collected between February 2016 and July 2017. The cohort was composed of 66% boys, 78% upper limb fractures. The peak fracture age was 12-13 in boys and 10-11 in girls. While the fracture rate on school days was 7.2 per day, with a 6% operation rate, the fracture rate during the summer vacation was 4.1 ($P < 0.011$) with a 14% operation rate ($P < 0.001$). Peak hours of admission were 12:00-13:00 and 18:00-19:00, with more moderate differences during non-school days and later hour peaks during holidays with traditional evening activities.

Conclusion To our knowledge this is the first report of a negative peak in paediatric fracture rate during summer vacations in comparison with schooldays. Our findings stand in contrast with most previous publications, but correlate with a recent report of a wane in the increase of fracture rates at peak summer. Further research needs to be conducted regarding the correlation of our findings with a probable lack of physical activities during long vacations, replaced by sedentary activities, and with safety measures taken in schools, playgrounds and sports activities for children.

Trauma

EP-066

The relationship between proper restraint type and long bone fractures in children involved in motor vehicle collisions

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Level III

Purpose The risk of mortality and morbidity in motor vehicle collisions (MVC) is significantly reduced when children are properly restrained, but data is limited about specific injuries associated with MVC. Objectives of this study were to determine if an association exists between specific restraints and a particular long bone fracture and if other injuries are common in properly restrained child passengers.

Methods We reviewed records of patients who were involved in an MVC and presented to the emergency department from January 2011 to July 2016. Patients 14 years old and younger who were restrained passengers were included in this study. Data collected included demographics, restraint type, MVC specifics, type of injuries, and clinical outcomes.

Results We reviewed 993 patients and 322 were properly restrained and included in the study. Of the 322 properly restrained patients there were 107 in a car seat, 57 in a booster seat, 142 in a lap-shoulder seatbelt, and 16 in a lap only seatbelt. There were 108 long bone fractures documented in 75 of the 322 patients (23%). Femoral fractures were the most common long bone fracture, followed by

fractures of the tibia and radius. Femoral fractures were found in 15/107 (14.01%) car seat restrained patients, 5/57 (8.77%) booster restrained patients, and 10/142 (7.04%) lap-shoulder restrained patients. Children in car seats were 2.2 times more likely to have a femoral fracture than children restrained in a booster seat or a lap-shoulder seat belt.

Conclusion Children in car seats had a higher frequency of femoral fractures than did children in other types of restraints. This information could be used to further improve car seat design and further refine policy regarding proper child restraints.

Trauma

EP-067

Results of intramedullary nailing open femoral fractures in children

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¹GCZD

Level I

Purpose Intramedullary nailing has become the treatment of choice for closed femoral shaft fractures in children and adolescents. But recently the series of patients with open femoral fractures treated using intramedullary nailing were published. The aim of this study is to evaluate the results of intramedullary nailing of open femoral fractures in children.

Methods From the 1st Jan 2001 to the 30th Jun 2016, 205 children were treated for femoral shaft fracture in our department. 22 fractures were opened in 21 patients. The mean age of patients was 12,1 years (5 to 16,5). Using the Gustilo-Anderson classification there were the type I in 14 patients, II in 4, IIIA-2, IIIB-1, IIIC-1. There were 7 transversal type fractures, 11 oblique, 4 comminuted fractures. The average Injury Severity Score for 19 patients was 30 (10 to 42). Time of surgery after trauma was 5,5 hours (2 to 26).

Results The mean follow-up was 64 months (14 to 145). 17 patients' bone consolidation was obtained 3 months post-op. 1 patient with deep infection presented bone consolidation 4,5 months post-op. Patient 16,5 years with open femoral fracture type II according to Gustillo presented infection with Staphylococcus aureus 19 days after procedure. Conversion from intramedullary to external fixation was used. Infection was stopped 6 weeks after trauma.

Conclusion 1. Treatment of open femoral fractures is a challenging problem 2. In children with polytrauma, multiple fractures, head injuries and other conditions which necessitate intensive nursing care, intramedullary nailing of opens femoral shaft fractures (type I, II, IIIA, IIIB) should be preferred.

Trauma

EP-068

Is the shoulder rotation immobilisation necessary after lateral percutaneous osteosynthesis in elbow supracondylar fracture in children and adolescent?

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Level IV

Purpose Supracondylar humeral fracture (SCHF) is a very common fracture in children, representing 3 % to 17.9 % of all children fracture. Surgical treatment and postoperative immobilisation is necessary for Gartland type II and III lesions. Closed reduction, and lateral percutaneous pinning is widely used. Postoperative immobilisation is necessary, but to the best of our knowledge, how this should be achieved is not as clear as one would imagine. Indeed, most French orthopaediatric departments use a long-arm cast or a posterior plaster splint associated with shoulder immobilisation (so-called « mayo-clinic ») to avoid shoulder external rotation reputedly responsible for fracture displacement. Other countries probably have different attitudes though this particular point has never been specifically studied. The aim of the current study was to evaluate our loss of reduction (LOR) rate using a single sling without shoulder immobilisation after percutaneous lateral pinning of SCHF.

Methods A retrospective monocentric study of children treated for SCHF between 2011 and 2015 was conducted. We included all patient treated by closed reduction and lateral percutaneous pinning. Postoperative immobilisation consisted in a posterior plaster splint and a simple sling. X-rays were performed preoperatively, postoperatively and at 6 and 12 weeks. A LOR was determined comparing 2 consecutives x-rays by a change >10 degrees of the Baumann and/or the humero-capitellar angle.

Results A total of 135 cases were reviewed. Eight LOR were observed, 3 out of 8 were rotation displacement. Five errors of osteosynthesis were identified and could explain 5 out of the 8 secondary displacements. The 3 remaining secondary displacements were not in rotation and could not be avoided by shoulder immobilisation.

Conclusion A plaster splint added to a simple sling is sufficient to postoperatively immobilized SCHF operated on by lateral percutaneous pinning provided the osteosynthesis is correctly performed.

Trauma

EP-069

A new technique of elastic stable intra-medullary nailing to treat fracture of the distal third of tibia: the divergent intra-medullary nailing

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Level IV

Purpose Elastic Stable Intra-medullary Nailing (ESIN) is an efficient osteosynthesis to reduce and stabilise fracture of the tibia shaft in older children and adolescent. However, in

fracture of the distal third of the tibia traditional ESIN could provide unsatisfactory reduction that compromises the stability and the healing of the fracture. The aim of this study was to present and to assess a new technique of modified ESIN to treat fracture of the distal third of the tibia, called Divergent Intra-medullary Nailing (DIN).

Methods A retrospective monocentric study was conducted in our orthopaediatric department. All patients, less than 16 years old, operated on according to the DIN technique for a displaced and/or unstable fracture of the distal third of the tibia were included. Demographic and surgical data were collected. X-rays were performed preoperatively, postoperatively, at 6 weeks and every 6 months. Surgical technique started as the classical ESIN for a tibial fracture. However, nails were not curved in order to cross only once at the proximal part of the tibia. Thus, nails were divergent and supported on the medial and lateral distal part of the tibial shaft. The divergence of the nail reduced and stabilised the fracture.

Results Eleven patients were included, with a mean age at 10 years old and a mean follow-up at 16 months. The size of the nail was 30, 35 or 40 mm. The mean surgical time was 55 minutes. The Din technique provided a satisfying reduction for the 11 fractures. And, there was no secondary displacement at 6 weeks. All patients healed at 6 months with no clinical torsion or axis malalignment.

Conclusion The current study confirms the feasibility and the efficiency of the DIN method to treat fracture of the distal third of the tibia.

Trauma

EP-070

Hip spica application for femoral fractures in children -- do we need to do this in the operating theatre?

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Level IV

Purpose Hip spica casting remains the standard treatment of femur fractures in young children. This study aims to evaluate the application of a spica cast in the operating theatre (OT), versus the outpatient clinic or emergency department (ED). Quality of fracture reduction, associated complications, and hospital charges are compared.

Methods Seventy-seven children aged 6 months to 8 years between January 2008 and December 2015 with an isolated femur fracture and treated with a hip spica cast were identified retrospectively. Patients were compared based on the location of spica cast application.

Results There were 11 patients in the ED cohort and 55 patients in the OT cohort with no significant differences in age, sex, proportion of unacceptable reduction during period of casting, and rate of revision casting between cohorts. A greater proportion of spica casts done in OT were displaced femoral fractures (100% vs. 54.5%; $p < 0.01$). Spica casting in the OT delayed the time from presentation to cast placement

(16.3h vs. 2.25h) and lengthened the average hospital stay (39.6h vs. 22.8h). Excluding the undisplaced fractures, there were no significant differences in the duration of spica cast and median length of follow-up. The average hospital charges of spica cast application in the OT were about 1.5 times more than the cost of casting in ED.

Conclusion Spica casting in ED and OT provided similar results in terms of reduction and associated complications. With significantly higher hospital charges for spica casting in the OT and longer hospital stay, alternative clinical areas should be considered for hip spica application. Hip spica casts for femur fractures applied in the emergency department or outpatient clinic setting is evidently time and cost effective, with no compromise to the quality of fracture reduction.

Trauma

EP-071

Complications of proximal femoral fractures in children

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Level IV

Purpose The aim of the study is to investigate the incidence of complications and factors related to its occurrence after sustaining a proximal femoral fracture in children.

Methods 375 children younger than 14 years with a femoral fracture were reviewed, and patients with a proximal femoral fracture were selected. Demographic data, location of fracture, mechanism of injury, type of treatment and complications were noted.

Results We found 18 (5%) patients with a proximal femoral fracture: 14 extracapsular and 4 intracapsular. Age distribution was bimodal: 4 and 13 years. Regarding intracapsular fractures, we found three transcervical fractures and one basicervical, being all of them caused by a high-energy traumatism. Treatment of intracapsular fractures was: ORIF in two cases; closed reduction, joint puncture to release intraarticular pressure and fixation with a sliding screw plate in one case; and traction followed by a spica cast in another one. After a mean follow up of 7.4 years, we found an AVN in the two patients where fracture was reduced by closed means. Regarding extracapsular fractures, mechanism of injury was a simple fall in 7 and a high-energy traumatism in the other 7. Treatment of extracapsular fractures was: in-situ spica cast in 3; skeletal traction followed by spica cast in 5; ORIF with a sliding screw plate in 5; and closed reduction and percutaneous pinning fixation in 1. After a mean follow-up of 2 years, we found a malunion in three patients, all of them treated conservatively (spica cast with or without previous traction). No cases of nonunion or AVN were described.

Conclusion Intracapsular femoral fractures in children are caused by a high-energy trauma and associate a high risk of AVN, especially if fractures are reduced by closed means. Extracapsular fractures are associated with malunion if non-surgical treatment is performed.

Trauma

EP-072

The utility of intra-operative arthrogram in the management of paediatric lateral condyle fractures of the humerus

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Level III

Purpose While intra-operative elbow arthrograms are commonly used to assess articular reduction during closed reduction and percutaneous pinning (CRPP) of paediatric lateral condylar humerus fractures (LCHF), there is no consensus on the indications or timing of arthrogram use. This study seeks to determine how intra-operative arthrogram affects the management of paediatric LCHF's.

Methods All LCHF's treated with CRPP at a level I paediatric trauma center from 2008-2014 were retrospectively reviewed. Injury parameters, initial and postoperative fracture displacement and complications were compared between fractures managed with and without an arthrogram as well as between those that had an arthrogram prior to fixation and those in which the arthrogram was performed following CRPP.

Results 107 patients underwent attempted closed reduction in the operating room. 58 patients (54%) underwent CRPP without arthrogram and 49 patients (46%) underwent CRPP with an arthrogram. Of those who had arthrograms, 27 (25%) were performed prior to fixation and 22 (21%) had an arthrogram after fixation. There was no difference in mean age, weight, or pre-operative displacement-based arthrogram use or timing. Mean postoperative displacement was significantly lower in the no-arthrogram group versus the arthrogram group (0.9mm vs 1.7mm; $p<0001$), but did not differ based on arthrogram timing ($p=0.08$). Arthrograms changed management in 4/49 (8%) of patients. In all cases where an arthrogram changed management, it was performed prior to definitive fixation. There was, however no significant difference in the rate of changed management by arthrogram timing (15% before fixation versus 0% after fixation, $p=0.060$).

Conclusion While elbow arthrogram following CRPP of LCHF's may be useful to assess final fracture alignment, it is unlikely to result in a treatment change and was not associated with improved postoperative alignment.

Trauma

EP-073

A positive posterior fat pad sign predicts a successful treatment of Gartland III supracondylar fractures of the elbow in children by means of the Blount method

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Level III

Purpose Closed reduction and percutaneous pinning is deemed the standard treatment of Gartland III supracondylar fractures in children. However, pin insertion is accompanied by significant morbidity, such as infection or iatrogenic nerve injury. On the other hand, proper pin placement may lead to increased intraoperative radiation exposure of the orthopaedic surgeon and the patient. A positive posterior fat pad sign implies a continuous posterior capsule and periosteum. Subsequently, posterior fat pad positive Gartland III supracondylar fractures may be candidates for a successful stable closed reduction and nonoperative treatment by means of the Blount method.

Methods 69 Gartland III supracondylar fractures that were treated from 2011 to 2016 were studied retrospectively. The fractures had no sign of vascular compromise. All fractures had an attempt of closed reduction under anaesthesia. 42 fractures had a stable reduction in 120 degrees of flexion and were treated by means of the Blount method. The remaining 27 fractures had no stable reduction in flexion and were pinned percutaneously.

Results The frequency of a positive posterior fat pad sign was significantly higher ($p<0,05$, chi square) in the fractures that were treated by the Blount method (26/42 patients, 62%) compared with the fractures that were percutaneously pinned (10/27, 37%). The long-term results, in terms of range of motion, axial alignment of the elbow or nerve palsy were comparable between both groups and in accordance with the published literature.

Conclusion The posterior fat pad sign may represent more than just a diagnostic clue for occult nondisplaced fractures of the elbow. It may predict a successful nonoperative treatment of Gartland III supracondylar fractures by means of the Blount method, leading to less operative time, less radiation exposure of the surgeon and the patient and less surgery associated morbidity for the patient.

Trauma

EP-074

The use of negative pressure wound therapy in paediatric traumatic wounds

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Level III

Purpose Traumatic wounds can harm patients functionally and aesthetically, because of their severity, as well as the treatment used - extensive reconstructive surgery methods affecting another anatomical segment, the donor area. The use of Negative Pressure Wound Therapy (NPWT) can minimize these methods, reducing the surface of the soft tissue defect by

covering it with granulation tissue, thus creating a skin graft receptor bed. This study is a step in a PhD ongoing research phase, that tends to demonstrate the clinical outcome and the effectiveness of NPWT in paediatric traumatic wounds.

Methods The study includes 14 paediatric patients, with torn wounds and large soft tissue defects, receiving NPWT. An analyse included the demographic data, wound aetiology, associated injuries, associated surgical procedures, time to NPWT initialization, time to closure, closure method, duration of NPWT, dressing change frequency, number of dressings used, pressure modes, complications.

Results The 14 patients (sex ratio F:M 3:4, mean age 10 years), suffered from traumatic wounds (13 road accidents and 1 electrical burn). On average, the treatment was initialized 2,6 days after trauma and the mean duration of NPWT was 25,8 days. Continuous and variable pressure modes were used, all wounds reached full closure in an average time of 30,77 days, following NPWT and split thickness skin graft. The dressings were changed with a frequency of 3 to 5 days, using polyurethane foam. All patients needed associated surgical procedures: debridement of the necrotic tissue (14), excision of devitalized bone (4), fracture reduction and fixation (6). One complication related to haemorrhage of the bone tissue after NPWT initialization and one related to infection were noted.

Conclusion Using NPWT, as well as systemic antibiotics, surgical debridement, fracture stabilization and fixation in this population, resulted in rapid granulation tissue coverage and 100% successful wound.

Trauma

EP-075

Relevance of MRI for management of non-displaced lateral humeral condyle fractures in children

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Level III

Purpose The treatment for non-displaced fractures of the lateral humeral condyle in children is controversial. Most studies recommend non-surgical treatment. However, plain radiographs are not sufficient to evaluate extension of the fracture line through the articular cartilage. This explains the high frequency of secondary displacements and non-unions, despite well-conducted conservative treatment. We hypothesized that MRI could be used to analyse whether the fracture is complete or incomplete. This could help to determine whether surgical or conservative treatment is indicated.

Methods This prospective study enrolled children being treated for a non-displaced (< 2 mm gap) fracture of the lateral humeral condyle. All patients were treated with a long-arm cast in the emergency room. An MRI was done later on without sedation. A specific protocol was used to reduce the duration of the examination. T2-weighted and proton density fat-saturated sequences were used.

Results Twenty-seven patients were enrolled: 16 boys and 11 girls with a mean age of 5 years (2--10). MRI was performed an average of 7 days (1--23) after the fracture. The MRI could not be interpreted in two cases because the child had moved during the examination. In the other 25 patients, the fracture was incomplete in 17 patients and complete in 8 patients. Two children had secondary displacement diagnosed 7 and 11 days after the fracture event. These two patients underwent open reduction and internal fixation. There was no correlation between patient age and the fracture being complete or incomplete. There were no cases of nonunion.

Conclusion MRI appears to be a reliable method for determining whether the fracture line is complete or incomplete. Use of an injury-specific MRI protocol reduces the length of the examination, thereby improving its performance. We recommend that it be used to analyse non-displaced fractures of the lateral humeral condyle in children.

Trauma

EP-076

Reconstruction of part of distal radio growth plate with an autologous graft of iliac crest in a 12-years-old male and a literature review

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Level IV

Purpose Complete or partial epiphysiodesis is one of the main complication of physeal fracture. This is a rare complication, however when it occurs deformity may develop. Thus, we present a case of patient that had developed angular deformity of the distal radio and who underwent to reconstruction of part of distal radio growth plate with autologous graft of iliac crest. Moreover, a literature review was conducted in order to verify outcomes of this and similar techniques.

Methods A 12-year-old male patient was referred in our paediatric unit for the development of angular deformity of the wrist after a physeal fracture of the distal radio. After imaging study, the patient was treated by osteotomy for correction of angular deformity and with reconstruction of part of distal radio growth plate with autologous graft of iliac crest. Literature review was performed in Pubmed and Medline.

Results After a 3.5-year-follow-up the radio maintained the correction, and the distal radio has growth symmetrically respect contralateral radio without shortening or angular deformities. Range of movement was completely restored and the patient returned to normal daily and sport activities.

Conclusion The treatment of growth plate epiphysiodesis is challenging and surgical correction often may not be delayed. The literature offers different options to treat this condition. However, to the best of our knowledge this is the first case that reports the reconstruction of growth plate with autologous graft of iliac crest in human. Although this is a report of a single case, animal studies demonstrate the safety and efficacy of this method.

Trauma

EP-077

Gartland type 2 supracondylar humerus fractures: use of nitrous oxide for closed reduction and casting

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Level IV

Purpose Gartland type 2 supracondylar fracture's treatment is still controversial. The purpose of this study was to evaluate clinical, functional and radiographical results of Gartland type 2 supracondylar humerus fractures treated by reduction and casting in emergency room using nitrous oxide as conscious sedation.

Methods A retrospective review was performed on 26 children who sustained a Gartland type II supracondylar humerus fracture between January 2014 and December 2015. All patients were treated nonoperatively using nitrous oxide during reduction and casting in emergency room. Immediate post-reduction and final radiographs were evaluated. Baumann's angle, Carrying's angle, metadiaphyseal-angle and lateral humerocapitellar angle were measured. All patients were asked to complete the Numeric Pain Intensity (NPI) scale after fracture's reduction and the Quick DASH at last follow-up. Grading of results was recorded according to the Flynn criteria.

Results Of 35 elbows that underwent an initial reduction, 26 (74%) maintained alignment and were included in the study, 6 (17%) lost position and underwent a secondary reduction and pinning. Three (9%) patients were lost after two months of follow-up. The mean follow-up was 12 months (range: 6 to 34). Analysis of final radiographs showed that the mean Baumann's angle was 72.8 degrees (range: 60 to 84), the mean Carrying's angle was 6.37 degrees (range: 3 to 12), the mean metadiaphyseal-angle was 87.1 degrees (range: 75 to 93) and the mean lateral humerocapitellar angle was 59.5 degrees (range: 44 to 94). Mean NPI was 3 (range to 6). Mean QuickDash was 22.4 (range: 19 to 40).

Conclusion Use of nitrous oxide for closed reduction and casting in Gartland type 2 supracondylar fractures is a safe, cheap, painless and appropriate method to achieve fracture's alignment.

Trauma

EP-078

Displaced fractures of the proximal humerus in children cause long-term sequelae

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Level II

Purpose Due to the great remodelling potential of the proximal humerus, paediatric displaced fractures of the proximal humerus are thought not to cause any long-term problem. This study aims to assess the long-term functional outcome of displaced fractures of the proximal humerus in children.

Methods Thirty-three consecutive patients were included. Demographic data, fracture pattern, treatment and complications were noted. The Constant-Murley score and the QuickDASH questionnaire were used to assess outcome. The neck-diaphyseal angle was measured on initial, consolidation and final follow-up radiographs.

Results Average age at the time of fracture was 10 years (SD 3.5). Mean follow-up was 10 years (SD 4). The commonest pattern of fracture was a simple metaphyseal fracture in children younger than 12 years ($p=0.039$) and a Salter-Harris type 2 fracture in children older than 12 years ($p=0.004$). Seventeen patients were treated conservatively with gently reduction and immobilization, whereas sixteen patients were treated surgically (10 closed reduction and 6 open reduction, all followed by percutaneous pinning). Patients complained of pain with activities 4, loss of strength 6, inability to perform sports or play instruments 5, apprehension 1 and aesthetic deformity 1. Constant-Murley score was 72.5 (SD 4.8), Quick-DASH score was 3.5 (SD 7.2), and Quick-DASH Sports was 13.8 (SD 25.8) Four patients (12%) had mild-moderate disability for daily living (QuickDASH 12.2-29.5) and six (18%) had severe disability for sports and recreational activities (QuickDASH Sports 37.5-87.5). Mean neck-diaphyseal angle at the latest follow-up was 130 degrees (SD 9). There was varus malunion (<125 degrees) in eight patients (24%). We were unable to identify factors related to the occurrence of symptoms in the long-term.

Conclusion Some patients suffer mild-moderate disability once they became adults after sustained a paediatric displaced proximal humeral fracture. Further studies should be conducted to identify risk factors.

Trauma

EP-079

Best practice tariff in major trauma: insights from a United Kingdom level 1 children's major trauma centre

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Level III

Purpose In the NHS, standards of practice in major trauma have been established. Accordingly, an uplift payment is allocated when best practice is achieved. This study reviews the most severely injured children presenting to a level 1 trauma centre who qualified for the best practice tariff (BPT) and questions the utility of such a tariff.

Methods All paediatric major trauma calls presenting between July 2015 and June 2016 were retrospectively reviewed from a prospectively collected database. Children eligible for BPT were extracted from a national database managed by the Trauma Audit & Research Network (TARN). Baseline characteristics, injury parameters and outcomes were analysed from electronic patient records.

Results Of the 230 major trauma calls that presented over the year, only 47 (20%) qualified for BPT with the provider reimbursed according to national approved tariffs. There were 32 boys and 15 girls with a mean age of 8.5. 41 children were brought in by ambulance (89%), 4 by helicopter (9%) and 1 was brought in by their parent (2%). The mean GCS and ISS were 11.9 ± 4.3 and 17 ± 10.2 respectively. The most common mechanisms of injuries were road traffic accident (45%) and fall from height (32%). Head injury accounted for 38% (N=18), closely followed by lower limb fractures (32%, N=15). Seven cases were investigated for non-accidental injury, whereas two resulted in death. The median in-hospital length of stay was 6 days (IQR 5) and 12 children (26%) required admission to intensive care. Surgical intervention was required for 28 cases (62%).

Conclusion This study provides an overview of a cohort of injured children who received BPT in major trauma care. It reflects the stringency of the system as most children did not qualify for BPT despite substantial resource that typically goes into the management of each major trauma case.

Trauma

EP-080

A new method of elastic stable intra-medullary nailing to treat fracture of the distal diaphyso-metaphyseal junction of the radius

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Level IV

Purpose Elastic stable intra-medullary nailing (ESIN) is a gold standard of unstable shaft diaphyseal fracture in children and adolescent. However, to treat fracture of the distal diaphyso-metaphyseal junction (DDMJ) of the radius ESIN could be difficult to perform and unable to stabilize the fracture. Indeed, the shortness of the distal bone fragment does not allow a sufficient support to the nail to reduce and stabilize the distal fragment. Frequently an axial translation remains at the fracture site. The aim of the study was to present and to assess a modified method of ESIN to reduce and stabilize fracture of the DDMJ of the radius.

Methods Surgical technique starts as the classical ESIN of the radius. When the nail reaches the proximal growth plate of the radius, the nail is removed by 4 cm and the nail is curved by 90° at its extra-osseous part. Then, the nail is raised until the proximal growth plate of the radius. A retrospective, monocentric study was conducted in our orthopaediatric

department. All patients operated on according to the modified method of ESIN to treat fracture of the DDMJ of the radius were included. X-rays were performed preoperatively, postoperatively, at 3 and 6 months. The following measurements were performed, using axis the proximal and the distal bone fragment, to assess the reduction at the fracture site: frontal translation, frontal and sagittal angle.

Results Postoperative angulation measurements were stable on the different x-rays. Values of angulation were: frontal translation 3 mm \pm 2, frontal angulation $3.5^\circ \pm 5$, sagittal angulation $1^\circ \pm 3$. All patients healed at 3 months and the mean operative time was 47 min.

Conclusion The current study confirms the feasibility and the efficiency of the modified method of ESIN to treat fracture of the DDMJ of the radius.

Trauma

EP-081

The utility of mini C-arm in the fixation of unstable paediatric supracondylar humeral fractures

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Level III

Purpose Supracondylar humeral fractures (SHF) are the most common elbow fractures in children. Displaced SHF are unstable and require closed reduction percutaneous pinning with conventional C-arm fluoroscopy (CCA) guidance. However iatrogenic radiation exposure remains a concern as it increases the lifetime risk of cancers, especially in the paediatric patient. Radiation to both patient and surgeon can be significantly reduced by using a mini C-arm (MCA) system instead. We aim to compare the operative parameters and outcomes of SHF fixation using the MCA versus the CCA in our hospital.

Methods Retrospective review of 193 consecutive patients with Gartland IIB and III SHF who underwent closed reduction and percutaneous pinning was performed. 44 and 149 of these were performed with MCA and CCA respectively. Postoperative anterior-posterior and lateral radiographs were compared. The accuracy of the reduction was assessed by the Baumann's angle and anterior humeral line. A satisfactory reduction was determined by an angle between 64 and 81°, and an anterior humeral line which intersected the middle third of the capitellum. Surgical time, fluoroscopy duration, the number of shots and radiation exposure were obtained from the surgical notes.

Results It was found that for the CCA cases, there were greater satisfactory coronal plane reductions ($p < 0.05$), while no difference in sagittal plane accuracy ($p > 0.05$). In the MCA group, there were longer surgical ($p < 0.05$) and fluoroscopy time ($p < 0.05$) and a larger number of shots taken ($p < 0.05$). Despite so, overall radiation the MCA group was still lesser ($p < 0.05$).

Conclusion Using an MCA system in SHF fixation may be less accurate, particularly in the coronal alignment, and poses a challenge in obtaining clinically useful images intraoperatively. However, the pitfalls can easily be mitigated if the surgeon is aware of them, and its use should be strongly considered as overall radiation exposure can be greatly reduced.

Trauma

EP-082

A closed loop audit of paediatric upper limb fracture manipulation in the children's emergency department: have the new guidelines for MUA under 70% nitrous improved treatment?

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Level III

Purpose Paediatric forearm and distal radius fractures are common, frequently requiring closed reduction and plaster immobilisation under general anaesthetic. New children's emergency department (CED) guidelines were implemented in December 2016 for reducing these fractures in CED using 70% nitrous sedation.

Methods We performed an audit of all fractures presenting to CED from Feb-June 2016 and re-audited the same period in 2017 after guideline implementation. Fractures were identified using our trauma admission database and PACS. Demographics, treatment modality and timings were reviewed.

Results 126 patients were identified, 66 patients in 2016, 60 patients in 2017. Overall 56% were distal radius, 44% forearm fractures, 67% male, mean age 9.3yrs. In 2016, 36/66 patients (55%) were suitable for MUA under nitrous. 1/36 was manipulated in CED (reduction lost, patient underwent ORIF). 33/36 (92%) underwent MUA under general anaesthetic (GA), 2/36 GA with K-wires. In 2017, 35/60 patients were suitable for MUA under nitrous. Of those 20/35 (57%) were manipulated with nitrous, 15/35 (43%) treated with MUA under GA. 11/15 patients were not given nitrous due to staffing. Average time at presentation in the nitrous group was 16:42hrs vs. 18:08hrs for those not manipulated due to staffing. Waiting time for theatres was 2.5 days in 2016 and 2.2 days in 2017. Nitrous groups waited an average of 2hrs 29min between presentation X-ray and post reduction film.

Conclusion New guidelines have reduced the number of GA's required to treat these fractures with no change in outcome. Further CED training in nitrous sedation will reduce the number of GA's required. Time to treatment was reduced from 2.2 days under GA to 2.5 hours with Nitrous. This represents significant cost savings for the institution and savings in time, inconvenience and risk for the patients.

Trauma

EP-083

Factors associated with quality of reduction of paediatric supracondylar fractures of the humerus

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Level II

Purpose Complications of paediatric supracondylar fractures of the humerus, such as cubitus varus or lack of flexion, are associated with a malunion. For that reason, it is important to investigate the factors upon which depends quality of reduction of these fractures.

Methods 279 supracondylar fractures treated surgically were reviewed. Data regarding age, gender, side, time of admission, time of surgery, time waiting for surgery, duration of surgery, type of reduction, type of surgeon, and complications were recorded. Radiographs were evaluated to describe, pre-operatively, direction of displacement and, postoperatively, quality of reduction, number of pins, medial pin, pinning configuration and pinning errors. Two senior paediatric orthopaedic surgeons graded reduction of the fracture as correct or incorrect.

Results Fractures were 27% Garland II, 70% Gartland III, and 3% flexion type. Mean age was 6.2 years (SD 2.7). Displacement was as follows: posterior 20%, posteromedial 34.5%; posterolateral 41.5%; and anterior 4%. Mean time delay to surgery since admission was 5,7 hours. Mean duration of surgery was 35 minutes. Closed reduction in 90%. A medial pin in 13%. Pinning configuration was divergent 25%, parallel 25%, convergent 37% and crossed 13%. Pinning errors occurred in 45%: type A 3%, type B 14% and type C 28%. Complications occurred in 33%. Interobserver agreement regarding quality of reduction was substantial (Kappa 0,606). Quality of reduction was statistically associated with type of fracture ($p<0.001$), direction of displacement ($p=0.015$), time delay to surgery ($p=0.035$), number of pins ($p=0.039$), pinning error ($p<0.001$), and complications ($p=0.007$). A general orthopaedic surgeon tended to obtain a worse reduction ($p=0.071$).

Conclusion A paediatric orthopaedic surgeon should operate these fractures if possible. Pinning errors should be avoided. Flexion type and posterolateral displaced fractures are especially prone to obtain a worse reduction.

Trauma

EP-084

Operative management of supracondylar humeral fractures in children: comparison of five fixation methods

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Level IV

Purpose The best method for stabilising supracondylar humeral fractures (SHFs) in children remains unclear. The objective of this study was to compare the outcomes of five different fixation methods for SHFs in children.

Methods We reviewed the medical files of paediatric patients admitted for Gartland 3 SHF. Parameters collected post-operatively and at last follow-up included Baumann's angle, anteversion of the distal epiphysis, and operative time. 251 patients were included. The five fixation methods used were elastic stable intra-medullary nailing (ESIN, n = 16), two pins in an X configuration (n = 33), two lateral pins and one medial pin (n = 144), two lateral pins (n = 33), and three lateral pins (n = 25). A minimally invasive 2-cm approach was used to insert the medial pins. Immediate instability of the fixation was considered in patients with an at least 15° deficit in Baumann's angle or anteversion, or with rotational malalignment, on the radiographs taken on day 1.

Results Immediate instability showed no significant differences across the five groups. Operative time was significantly shorter with two lateral pins (33 min, P=0.046). Time to hardware removal was longer in the ESIN group (54 days, P=0.03). Use of a medial pin was associated with a lower risk of secondary displacement (2.0% vs. 8.6%, P=0.04) but did not affect the risk of nerve injury (4% vs. 3%, P=0.86).

Conclusion This is one of the largest retrospective cohort studies of outcomes according to the fixation technique used to treat SHFs in children. Adding a medial pin through a minimally invasive approach is associated with a longer operative time but limits the risk of secondary displacement without increasing the frequency of iatrogenic nerve injury. Use of a medial pin therefore deserves to be considered in paediatric SHFs.

Upper extremity

EP-085

Transphyseal humeral separations: what can we learn?

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Level II

Purpose Transphyseal humeral separations (TPHS) are rare injuries with only case reports and small series reported in the literature. The purpose of this study was to assess the various injury patterns, treatments, outcomes, and complications in a large series encompassing multiple institutions.

Methods A retrospective review was conducted at five paediatric institutions to identify all transphyseal humeral separations in patients 0-3 years of age from 1991-2016. Patient

demographics, mechanism of injury, Child Protective Services involvement, diagnostic modality, time to surgery, configuration, and complications were recorded. Frequencies and means were recorded for demographic and epidemiological analysis.

Results Seventy-nine patients aged 0-46 months, with a mean of 17.6 months, were identified. The most common mechanism of injury was accidental trauma (62%), followed by non-accidental trauma (27%), Caesarean section (7%), and vaginal delivery (4%). Child Protective Services were involved in 49%. Additional injuries were noted in 19 patients; most commonly additional fractures of the humerus, ribs, and skull. Time to surgery was greater than 24 hours in 62% of patients (n=49). Intra-operatively, 87% of patients underwent an arthrogram (n=69), 78% of patients had lateral pins only (n=62), 80% had two pins for fixation (n=63), and two patients underwent an open reduction. Ten complications were noted, including decreased range of motion (n=4) and cubitus varus/valgus (n=6) (8%). No cases of avascular necrosis or physal arrest were found. No loss of reductions occurred.

Conclusion Transphyseal humeral separations have excellent outcomes in the vast majority of patients. We recommend high suspicion for non-accidental trauma with transphyseal humeral separations as Child Protective Services involvement was required in over half of the non-birth related injuries. The most common complication was distal humeral deformity; patients should be followed beyond pin removal to evaluate for residual deformity.

Upper extremity

EP-086

Variation amongst orthopaedic surgeons when treating fifth metacarpal neck fractures in the paediatric population

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Level II

Purpose Fifth metacarpal neck fractures are common fractures affecting the paediatric population. However, no true standardization exists regarding their treatment. The purpose of this study was to determine if variation exists amongst orthopaedic surgeons in treating paediatric fifth metacarpal neck fractures and determine the factors regarding this variation.

Methods Twenty-five sets of images of paediatric fifth metacarpal neck fractures with posteroanterior (PA), oblique, and lateral views were identified. Fracture angulation measurements were made for the lateral and oblique views, with half of the images unmarked to assess the effect of marked angulation on treatment decision. Five images were duplicated to assess variability of a surgeon's treatment choice. Each set of

images was accompanied by the patient's gender and age. The images, along with a brief demographic questionnaire, were evaluated by 25 orthopaedic surgeons. A mixed effect model with the respondent as the random effect to determine which patient/radiographic factors were most associated with a decision to operate was performed.

Results Age and angulation were the factors found to be significantly associated with a surgeon's decision to operate. Patient gender, cast status, and whether or not an image was marked had no association with a surgeon's decision to operate. Greater than 50% of surgeons would choose surgical intervention if the degrees of angulation in the PA and lateral views were $\geq 55^\circ$ and $\geq 47^\circ$, respectively. Age alone was also identified as an independent factor for choosing operative intervention, with 42% of surgeon's operating on patients aged 17 years.

Conclusion Treatment of fifth metacarpal neck fractures in the paediatric population is not standardized. Worsening angulation above approximately 50 degrees and increasing age (adolescence) appear to be the most important factors when deciding to operate. Improved treatment algorithms based on outcomes studies are needed to determine the optimal treatment.

Upper extremity

EP-087

Medial epicondyle fractures in paediatric patients: to operate or not?

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Level III

Purpose Medial epicondyle fractures represent 10% of elbow fractures in paediatric age. Non-operative treatment is recommended for minimally displaced fractures (<5mm) and surgical treatment is recommended when the epicondyle is incarcerated in the elbow. Treatment is controversial in all other situations. We aim to compare the results obtained with nonoperative versus operative treatment of medial epicondyle fractures with displacement >5mm.

Methods Retrospective study, including patients diagnosed with medial epicondyle fracture treated in our institution, period 2011-2016. Of 37 patients identified, we excluded 15: 10 had displacement <5mm; 5 because the medial epicondyle was in the joint. Of the 22 remaining patients, 9 underwent surgical treatment by open reduction and internal fixation (ORIF) and 13 had non-operative treatment with cast 3 weeks immobilization (I). We compared the groups regarding gender, age, radiological displacement, associated lesions, complications, arch of motion (good if >100°) and functional outcome (QuickDash).

Results Group ORIF: 1 girl and 8 boys, median age of 11 years (8-15), median radiological displacement 10mm (6-17), 4 patients had associated lesions -- 3 elbow dislocations, 1

supracondylar fracture. A good arch of motion was obtained in 8 patients and median QuickDASH was excellent: 0 (0-4.5). Group I: 5 girls and 8 boys, median age 10 years (5-16), median radiological displacement 6mm (5-13), 1 patient had an associated lesion - dislocation of the elbow. A good arch of motion was obtained in 13 patients and median QuickDASH was excellent: 0 (0-4.5). Asymptomatic nonunion was observed in 0 patients treated surgically and 7 treated non-operatively, $p = 0.008$.

Conclusion The surgical treatment of fractures of the medial epicondyle with displacement > 5 mm does not offer better functional results than non-operative treatment. Nonunion is frequent in non-operative treatment, but usually asymptomatic. Controversy persists regarding the best treatment for these fractures and prospective studies are required.

Upper extremity

EP-088

Ulnar callus distraction in children with hereditary multiple exostoses: identified the risk factors affecting callus union

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Level IV

Purpose The forearm deformity classified by Masada are a characteristic trait of patients with Hereditary Multiple exostoses. The distal ulna always involved leading to an obvious shortening of ulna, which further results in bowing of the radius, ulna deviation of the wrist, dislocation of the radial head. Ulnar lengthening was popular in treating these difficult deformities. However, delayed consolidation of the callus or refracture of regenerate bone were observed in some patients, the aim of this study was to evaluate the potential risk factors of delayed union.

Methods Thirty-three patients (20 boys, 13 girls) with Hereditary Multiple exostoses-induced forearm deformity were treated by ulnar callus distraction combined with or without the excision of exostoses. Patients' demographic data, Masada deformity classification, treatment, type of external fixators and the healing index were record. Factors affecting healing index were analysed by multiple linear regression.

Results The mean healing index was 51.5 days/cm (rang 26.6-99.3 days/cm). The association between healing index and BMI is statistically significant ($p = 0.002$), patients with lower BMI means the increasing of the healing index. Age also showed a positive association between healing index ($p = 0.007$), these data confirmed that increased age was associated with greater healing index and consolidation time. Other factors included the Masada deformity, the right or left side forearm involved, excision of exostoses and the type of external fixators did not reach statistical significance in the regression mode.

Conclusion BMI and age has the most effect on healing index in patient with Hereditary Multiple Exostoses, when performed the callotasis in older children or patients with lower BMI, extra attention such as adjust the lengthening rate, should be paid to avoid delayed consolidation of the callus.

Upper extremity

EP-089

Intra-compartmental pressure monitoring in paediatric supracondylar humerus fractures

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Level II

Purpose Supracondylar humerus fractures (SHF) cause significant soft tissue swelling of the elbow. We aimed to monitor the intra-compartmental pressure changes in children with Gartner type III SHF fracture prior to and after reduction and percutaneous pinning.

Methods Thirty one children with Type III SHF fractures were prospectively followed. Eleven children underwent open reduction (OR) and percutaneous pinning, while 20 children were treated with closed reduction (CR) and percutaneous pinning. In the operating theatre, patients' forearm flexor compartment pressures were measured before reduction and immediately after percutaneous pinning using digital intra-compartmental pressure monitor. An indwelling slit catheter was placed inside the flexor compartment for extended pressure monitoring at every 4 hours till catheter removal at postoperative 24th hour. Differences between intra-compartmental pressures in closed and open reduction groups throughout time were analysed.

Results Mean preoperative compartment pressures were higher in cases which required OR. Surgery caused an immediate and significant rise in intra-compartmental pressures in both groups (13 mmHg to 26 mmHg in CR group, $p < 0,05$; 17 mmHg to 31 mmHg in OR group, $p < 0,05$), which then declined gradually till catheter removal. Mean postoperative compartment pressures were higher in the OR group, most significant at 12th hour. No patients developed compartment syndrome or nerve palsy following surgery.

Conclusion Patients who require OR present with higher preoperative intra-compartmental pressures. This may be due to extensive soft tissue injury which is expected to increase soft tissue swelling and hinder closed reduction. Furthermore, surgical reduction and fixation of SHFs cause a significant increase in forearm compartment pressures which is more pronounced in open reduction. Intra-compartmental pressures then gradually decline to nearly same levels in closed and open reduction patients in 24 hours. Early postoperative period is the time when patients are most sensitive to soft tissue swelling and need closest monitoring.

Upper extremity

EP-090

Establishment of normal ranges of upper extremity length, circumference and rate of growth in the paediatric population

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Level II

Purpose Upper extremity length and circumference abnormalities are present in a number of conditions in the paediatric population. In most cases, upper limb hypoplasia and hypertrophy are diagnosed when one limb appears substantially different from the other during the physical examination. However, occasionally when this discrepancy exists it can be difficult to determine which limb is the abnormal one. The purpose of this study was to establish normal values for upper extremity length, circumference and rate of growth in children ages 0-17.

Methods A total of 377 participants had four measurements taken of each upper extremity: upper arm length, upper arm circumference, forearm length, and forearm circumference. Statistical analysis was performed to identify differences and rates of growth.

Results Mean values for arm and forearm length and circumference for each age, 0 to 17 years, were established. The determination of a child's expected arm length is dependent on their height, age and gender, while the calculation of a child's expected forearm length depends on their weight, age, and gender. Expected arm circumference in paediatric patients can be determined by their height, weight, and age. In contrast, expected forearm circumference was independent of age, height, and gender, linked solely to patient weight. Male and female arms and forearms have similar growth rates of lengths and circumferences. No significant differences were found between right and left extremities for each of the four measurements taken.

Conclusion Contralateral limbs can be used a comparative for length and circumference of the arm and forearm in cases of unilateral upper extremity abnormality. The establishment of normal values for upper extremity length, circumference and growth rate will be a useful diagnostic tool for upper extremity hypoplasia and hypertrophy, allowing future studies to determine the impact of these variables.

Upper extremity

EP-091

Gartland type-IV supracondylar humeral fractures: preoperative radiographic features and a hypothesis on causation

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Level IV

Purpose Gartland type IV supracondylar fractures (GIV SCF) are defined by intraoperative instability in both flexion and extension. This study aims to characterize the preoperative imaging findings of these globally unstable fractures. We hypothesize that this injury is secondary to a trauma vector in the coronal plane (either varus or valgus) and that instability is caused by near-complete disruption of the periosteum at the fracture site, with an intact on the medial or lateral side only.

Methods Twenty-seven GIV SCF fractures were identified through retrospective review of operative reports and surgeon interview. Mean subject age was 7.4 years (range 2 years 9 months-12 years). We retrospectively reviewed all injury radiographs as well as the specific reduction techniques used intraoperatively, when available.

Results Preoperative AP radiographs demonstrated lateral translation or angulation in 21 cases (valgus type) and medial translation or angulation in 6 cases (varus type). In spite of a complete disruption of both anterior and posterior cortices, preoperative lateral radiographs showed that the distal fragment was always vertically aligned with the proximal fragment though often slightly rotated. In all cases pinning in semi-extension was favoured. For those fractures in which specific reduction techniques were mentioned, reduction was achieved via supination in valgus type fracture and pronation for varus type fractures.

Conclusion In this series, GIV SCF showed a constant radiological pattern on injury radiographs. Our hypothesis is that GIV SCF are produced by a trauma vector in the coronal plane (either varus or valgus) leading to a near-circumferential periosteal rupture in which either a medial or lateral hinge remains. GIV SCF can be identified on injury radiographs based on the above imaging characteristics. This information will help with surgical planning of this challenging fracture type.

Upper extremity

EP-092

An anatomic study of the development of the proximal humeral physis

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Level III

Purpose During maturation, the ossification centers of the proximal humerus fuse to form a characteristic growth plate pattern consisting of a metaphyseal peak and corresponding epiphyseal valley. Changes in the dimensions of the metaphyseal peak and epiphyseal valley with advancing age are not well described, but represent a potential practical methodology for estimating skeletal maturity as the shoulders are often visible on scoliosis radiographs. The purpose of this study

was to clarify the developmental anatomy of the proximal humeral physis.

Methods An anatomic study of 24 cadaveric proximal humeral epiphyses and metaphyses in specimens aged 3 to 18 years at the time of death was performed. Surface area scans of the proximal humeral metaphysis and epiphysis were obtained using a high-resolution 3-dimensional scanner. Computer modelling software was used to measure the peak height of the metaphysis and depth of the epiphysis relative to a perpendicular line drawn across the physis. Linear regression analysis was used to compare metaphyseal peak height and epiphyseal valley depth in predicting chronologic age.

Results Average specimen age at the time of death was 10.5 ± 4.3 years, consisting of 10 males and 14 females. The metaphyseal peak had a mean height of 15.2 mm (range, 8.9 to 21.1mm) while the epiphyseal depression had a mean depth of 12.6 mm (range, 7.6 to 19.0 mm). Both metaphyseal peak height (R²=0.60) and epiphyseal valley depth (R²=0.60) increased with advancing age. Logistic regression analysis demonstrated that epiphyseal depression + gender (R²=0.664) was more predictive of patient age than metaphyseal peak height + gender (R²=0.602).

Conclusion The metaphyseal peak and epiphyseal depression both increase with advancing age. Epiphyseal depression has the greatest correlation with patient age and represents the best target for future radiographic investigation into the use of shoulder anatomy to estimate skeletal age.

Upper extremity

EP-093

Growth of the capitellar ossific nucleus and its relationship within the lateral condyle of the distal humerus in skeletally immature elbows: a study using MR images

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Level IV

Purpose The anterior humeral line (AHL) and radiocapitellar line (RCL), which make use of the capitellar ossific nucleus (CON), are considered valuable radiologic parameters for the assessment of skeletally immature elbows. To more accurately interpret these radiologic parameters, it is necessary to understand the capitellar ossification pattern and its age-relationships within the lateral condyle. We therefore investigated age-related changes in CON, using MR images of skeletally immature elbows.

Methods MR images of the distal humerus from 79 children aged 1-16 years and free from demonstrable lesions were reviewed. The images were divided into 2-year interval age groups, with each age group including at least five cases.

Results On coronal MR images, the CON center was 46.1% lateral to the midline of the humerus. The distal cartilaginous vertex of the capitellum, which articulates with the center

of the radial head, was 60.0% lateral to the midline of the humerus. On sagittal MR images, the CON center was almost positioned with the AHL in older children, but was posterior to it in children with an age ≤ 6 years. On sagittal MR images, the anterior cartilaginous vertex of the capitellum was positioned within 10% of the level of the center of the CON in all age groups.

Conclusion We identified the following points during the interpretation of paediatric elbow radiographs. (1) The RCL on anteroposterior views ordinarily intersects the lateral side of the CON by about 15%p. (2) The AHL on lateral views intersects the center of the CON in older children, but passes anteriorly in younger (≤ 6 years) children. (3) The RCL on lateral radiographs invariably passes through the center of the CON. Recognition of the capitellar ossification growth pattern would aid in more accurate assessment of skeletally immature elbows on plain radiographs.

Knee

EP-094

Correction of leg length discrepancy by epiphysiodesis

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Level III

Purpose The treatment of choice for children with LLD between 1.5-2 cm and 4.5-5 cm is epiphysiodesis. Optimal timing of the epiphysiodesis is crucial to reach a good result, and there are several methods for calculating the expected LLD at maturity. Studies have proven that none of the methods are exact and no method has been shown to be clearly superior to the others. The purpose of this study is to evaluate our ability to correct LLD in children by epiphysiodesis at our department.

Methods At our department we have prospectively registered children with LLDs since 1991, and until now we have analysed 58 patients; 22 girls and 36 boys operated with epiphysiodesis. 10 patients were operated with isolated epiphysiodesis of the proximal tibia, 5 with isolated epiphysiodesis of the distal femur and 43 with a combined desis. The girls were aged 12.6 (10.3-15.4) years with bone age 11.8 (10-13) years, and the boys 14.3 (11.6-17.1) years with bone age 13.5 (11-15) years.

Results The Moseley Straight Line Graph (SLG) computer program (based on bone age) was used. In our material the average LLD at maturity without surgery was estimated to be 3.3 (0.6-6.7) cm and the average LLD at maturity with surgery 1.2 (0.0-3.5) cm. The Moseley predicted LLD compared with the final LLD was -0.8 (-4.6-3.6) cm.

Conclusion In 70 % of the patients there was a good correlation between the estimated and final LLD using absolute numbers. In our material the Moseley method tended

to result in undercorrection of the final LLD. The subjective estimation of bone age is probably the most critical parameter in the calculation.

Knee

EP-095

Outcome of minimally invasive technique of Judet's quadricepsplasty in children

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Level III

Purpose Knee extension contracture is a rare yet devastating disorder in children. Loss of knee flexion is commonly associated with congenital knee dislocation (CKD), Congenital patella dislocation (CPD) or neuromuscular disorders. Although quadricepsplasty is a well-known procedure in adult patients with post-traumatic stiffness there is a lack of studies regarding the outcome in children. Judet's quadricepsplasty is one of the most effective techniques for releasing the quadriceps to increase range of knee flexion. However, it carries a high risk for wound breakdown, infection and blood loss due to the large incisions and extensive soft tissue release. We report the outcome of Judet's quadricepsplasty using a minimally invasive approach that we developed in 4 children with knee extension contracture. The aim was to report outcome of Judet's quadricepsplasty using a new technique in children.

Methods Retrospective study included all patients with different pathology who had the studied procedure. Patients' notes were reviewed to identify postoperative complications. Pre-operative and postoperative ROM were compared and extension lag was documented.

Results 4 patients were included in our study, with average follow-up of 35 months. 2 patients had CKD, 1 chronic patella dislocation and 1 CPD. Preop flexion ranged between -20° to 40° whilst postoperative average flexion was 105° (2 patients 120° and 2 patients 90°). None of the patients had any significant wound problems, extension lag of 10-15° was reported in 2 patients while the 2 other patients had full extension. One patient had a post-traumatic patella fracture 13 months postoperative treated with reconstruction of extensor mechanism, otherwise no other patients had further surgeries.

Conclusion Judet's quadricepsplasty is an effective procedure for treatment of knee extension contracture in children (2 excellent and 2 good according to Judet's classification), our new technique has resulted in less postoperative complications compared to traditional approach.

Knee

EP-096

Outcomes following hemiepiphysiodesis in patients with idiopathic genu valgum using physeal staples versus tension band plating

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Level III

Purpose Pathologic genu valgum is defined as greater than 10° of valgus angulation about the knee that persists beyond age 8. The purpose of this study was to assess outcomes and factors affecting outcomes of hemiepiphysiodesis in patients with idiopathic genu valgum (IGV) treated with either physeal stapling or tension band plating (TBP).

Methods A systematic review of the literature was performed to identify articles examining the use of physeal stapling and TBP for the treatment of IGV in skeletally immature patients. Outcomes and factors influencing outcomes related to the rate of deformity correction and associated complications in patients undergoing hemiepiphysiodesis for correction of IGV using physeal staples or TBP were evaluated.

Results Review of the literature yielded 11 studies with 252 patients (n=501 knees). No significant difference in overall mean deformity correction (p=0.92) or correction per month (p=0.61) was appreciated between groups. Repeat hemiepiphysiodesis was more common in patients undergoing TBP versus physeal staples (p=0.05). A trend towards faster correction was appreciated in patients treated with physeal staples who were non-obese, younger (< 11 years in females, < 13 years in males) and male, along with patients treated with TBP at two physes compared to one. Patients younger than 12 years treated with TBP were at higher risk for repeat hemiepiphysiodesis compared to patients 12 years and older.

Conclusion TBP was not found to yield significantly improved results in regards to overall deformity correction, mean correction per month or complications when compared to physeal staples.

Knee

EP-097

Adolescents with quadriceps and patellar tendon autografts exhibit greater deficiencies in drop jump landing biomechanics than patients with hamstring tendon autografts

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Level III

Purpose Recent studies have demonstrated improved functional outcomes following ACL reconstruction (ACLR) with patellar (PT) and quadriceps tendon (QT) grafts over hamstring tendon (HT), but consensus is lacking regarding

optimal graft choice. This study compared drop jump landing biomechanics among patients with HT, PT, and QT ACLR.

Methods 60 patients with unilateral ACLR (27 HT, 20 PT, 13 QT; 4-11 months post-surgery, mean 6.4 months) and 26 controls age 13-18 years were evaluated during vertical drop jump landing. Lower extremity kinematics, kinetics, and asymmetry were compared across groups using ANOVA with Bonferroni post-hoc tests. Asymmetry was tested within groups using paired t-tests.

Results All ACLR groups exhibited lower peak vertical ground reaction forces, knee and ankle flexion moments, and knee and ankle sagittal power absorption on the operative side compared with the contralateral side and controls. ACLR limbs in all groups also had higher hip flexion angles, moments, and power absorption than controls. Knee abduction moments were higher on the operative side in all ACLR groups compared with the contralateral side and controls. The PT and QT groups had greater asymmetry of knee flexion moments and power absorption than the HT group, and significantly higher hip flexion moments on the operative compared with the contralateral side, suggesting better functional biomechanical profiles in the early postoperative phase in the HT group.

Conclusion Patients with QT grafts performed similarly to those with PT grafts during drop jump landing in the first year post-ACLR, while patients with HT grafts performed better than those with either PT or QT grafts. While appropriate graft choice should remain patient specific, longer term follow-up is needed to assess biomechanics, functional outcomes, and donor-site morbidity at later time points, which may all share an important role in elucidating the optimal graft choice in the adolescent ACLR patient population.

Neuromuscular

EP-098

Measurement of movement during daily life using accelerometers challenges desired upper limb gains with botulinum toxin injections

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Level IV

Eleven children with cerebral palsy of ages 4-12, GMFCS I-III were monitored with accelerometers before, 3 weeks after and 3 months after botulinum toxin injections in the legs. In a subgroup of 4 children, there was also a clinical indication for treatment of the upper limb. Accelerometers (Actigraph) were worn for four whole days on both wrists, the right ankle and the waist, while awake. A treatment goal on an activity level was to use the injected more affected arm more, but this long-term measurement of daily living showed that it was actually the dominant, non-injected arm that was moved more vividly and for longer time spans after

treatment. Injections of the legs did not change the acceleration of the waist during gait, i.e. the gait pattern was more or less unchanged, as was the typical asymmetric arm swing. The time the children spent walking was only 5% during awake hours, and even decreased to 3-4 % after treatment. In children who had clinical indications for getting botulinum toxin in the arm, the difference between the arms actually increased as the dominant, non-injected arm was moved more after injections. This study shows that botulinum toxin has previously unknown effects on movement in daily living, with an increased voluntary use of the better, un-injected hand. The reason could be a central nervous system effect of a release of the movements of the less affected arm, with diminished mirror movements.

Hip

EP-099

Early osteoarthritis after slipped capital femoral epiphysis: cartilage degeneration, residual deformity and patient-reported outcome

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Level IV

Purpose Slipped Capital Femoral Epiphysis (SCFE) results in a more or less pronounced deformity of the proximal femur sometimes causing impingement and early osteoarthritis. Arthroscopic bumpectomy and more extensive femoral or pelvic realignment osteotomies can be performed. However, the indications and prerequisites for successful surgery are not clear. The purpose was to study early osteoarthritis after SCFE and the association with deformity and self-reported hip function, pain and quality of life.

Methods Delayed-Gadolinium-Enhanced-Magnetic-Resonance-Imaging of Cartilage (dGEMRIC) quantifies and locates cartilage degeneration. Plain radiographs were used to measure deformity, alpha-angle. Oxford hip score, Hip Groin Outcome score and EQ-5D-Visual scale were used.

Results Nine women and 16 men, mean age 32.0 years (range 21.2-49.7), 19 with unilateral and 6 with bilateral SCFE participated. In the 19 unilateral SCFE on the slip side dGEMRIC mean value was 533 ms (112 SD, range 357-649) versus mean 589 ms (125 SD, range 320-788) on the non-slip side, $p=0.010$. The dGEMRIC correlated negatively to the alpha-angle, $CC=-0.60$, ($p=0.002$). Oxford hip score, pain and EQ-5D-Visual scale correlated to dGEMRIC $CC=0.43$ ($p=0.031$), $CC=0.40$ ($p=0.046$) and $CC=0.49$ ($p=0.013$) respectively.

Conclusion After SCFE, even relatively mild residual hip deformity can be associated with cartilage degeneration. A high alpha-angle was associated with worse cartilage status. The Oxford hip score identified symptoms even though our patients had not previously sought medical care. Quality of life showed strong inverse correlation with

cartilage degeneration. Objective assessment of early cartilage degeneration may be useful for treatment decisions and follow-up.

Foot

EP-100

Surgical treatment of tarsal coalitions yields good functional results

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Level IV

Purpose Surgical treatment is indicated in the management of tarsal coalitions associated with incapacitating symptoms. The usual procedure is resection of the coalition. Arthrodesis is reserved for severe cases. The objective of this study was to evaluate the functional outcome of patients undergoing surgical treatment of talocalcaneal and calcaneonavicular coalitions by means of open resection, arthroscopic resection or triple arthrodesis.

Methods A retrospective study was performed, including patients operated between 2005-2015. Patients with syndromic conditions or associated lower limb congenital deformity were excluded. Coalitions were evaluated regarding location, composition, laterality, age at time of surgery, type of surgical treatment and functional outcome measured through the Foot and Ankle Outcome Score (FAOS).

Results 32 patients, with 37 coalition were included. There were 16 boys and 16 girls aged 13.67 ± 1.88 years. The age at surgery was 14.78 ± 1.56 years (subtalar) and 13.2 ± 1.83 years (calcaneonavicular). Bony coalitions predominated (62.2%). The triple arthrodesis was performed in 55.6% of the talocalcaneal cases. In calcaneonavicular coalitions, the preferred technique was resection and interposition with bone wax (57.1%), being interposition of the extensor brevis muscle performed less frequently (35.7%). The follow-up time was 26.73 ± 19.33 months. In 3 cases (2 calcaneonavicular and 1 talocalcaneal) a reintervention was necessary: in 2 a triple arthrodesis was performed and in the other (calcaneonavicular), a resection was repeated. The functional outcome of these treated patients was excellent: mean FAOS 93.5 after treatment of talocalcaneal coalitions and 90.8 in calcaneonavicular coalitions. The mean FAOS of the talocalcaneal coalitions treated by triple arthrodesis was 93.13.

Conclusion The surgical treatment of the tarsal coalitions yields good functional results, even when triple arthrodesis is performed. Nonetheless, we currently prefer to perform arthroscopic resection surgery and joint preservation.

Foot

EP-101

Gait outcomes of idiopathic toe walkers treated surgically

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Level III

Purpose Idiopathic toe walking (ITW) is a diagnosis of exclusion associated with healthy children who persist to walk on their tiptoes after the age of 2-3 years. A lack of consensus remains for the treatment of this condition. ITW children without a limitation in ankle dorsiflexion are commonly treated with conservative interventions and children with a limitation in ankle dorsiflexion are sometimes treated surgically. Only a few studies reported gait outcomes pre-post surgery in this population. Therefore, the purposes of this study were a) to assess gait modifications after tendon Achilles lengthening in ITW b) to compare gait modifications in ITW treated surgically with ITW treated conservatively c) to assess gait recovery in ITW treated surgically compared to healthy children.

Methods 18 ITW children evaluated pre and post-treatment in our gait laboratory were retrospectively reviewed. Eleven children (pre: 9.1+/-2.1, post 11.1+/-2.1 years) had an Achilles tendon lengthening and 7 children (pre: 8.4+/-3.2, post: 10.4+/-3.2 years) had a conservative treatment (mostly physiotherapy). A group of 14 healthy children was included as a control group (12.2+/-1.5 years). Kinematics (MAPankle, value and time of maximal dorsiflexion during stance, 1st rocker) and kinetics (ankle moment and power) were compared between groups with non-parametric statistics (Wilcoxon Signed-Rank Test and Mann-Whitney U test).

Results All gait outcomes were improved after surgery ($p < 0.05$) (expected ankle power) and no modifications were observed in the conservative treatment group. Postoperatively, gait outcomes were statically different between ITW and the control group.

Conclusion This study showed that gait outcomes improve after surgery in ITW but they do not recover a normal gait. The improvement after a surgery is better than after a conservative treatment. These results should be confirmed by studies with a larger sample and with a longer follow-up.

Neuromuscular

EP-102

Does body mass index influence the progression of scoliosis in patients with cerebral palsy?

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Level III

Purpose Scoliosis is a major problem in patients with cerebral palsy (CP), but no consensus has been achieved regarding the scientific theory for the cause of scoliosis in CP. Our clinical suspicion is that children with lower body mass index

(BMI) diagnosed as having CP tend to have larger curves on presentation. The purpose of this study was to assess the association between BMI and progression of scoliosis in patients with CP.

Methods Seventy-one children (42 boys and 29 girls; mean age, 15.6 years) with CP (GMFCS IV: 25 and V: 46) were evaluated in a retrospective review. BMI was calculated in accordance with the measurements of supine height and body weight. The subjects were classified into two groups according to gender, and BMI ≥ 18.5 kg/m² or BMI < 18.5 kg/m². The relationship between BMI and scoliosis severity was evaluated using the Cobb angle (CA) measured using supine radiography.

Results The mean CA in the girls was significantly increased. A negative correlation was found between BMI and CA (boys: $r = -0.40$, $P = 0.01$ and girls: $r = -0.43$, $P = 0.02$). Between the two groups of BMI of ≥ 18.5 and < 18.5 kg/m², the mean CAs were $7.75^\circ \pm 5.19^\circ$ and $32.45^\circ \pm 34.19^\circ$ in the boys and $10.85^\circ \pm 20.65^\circ$ and $52.22^\circ \pm 39.73^\circ$ in the girls, respectively. Lower BMI was significantly associated with scoliosis progression in the patients with CP in both genders. Furthermore, lower BMI significantly affected the severity of scoliosis in the girls as compared with the boys.

Conclusion BMI was found to be an important indicator of scoliosis progression in the patients with CP, especially in the girls. Lower BMI could explain the progression and severity of scoliosis in CP patients, which might shed some light into preventive measures against CP scoliosis.

Infection, Tumours

EP-103

Total polyethylene endoprosthesis as reconstruction after complete humeral resection

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Level IV

Purpose Polyethylene endoprosthesis are a newly type of limb salvage procedure that they could aid to detect local recurrence sooner than prosthesis used currently.

Methods 11-year-old male patient reported 2-month history mechanical pain and functional impairment in his left shoulder after two low-energy traumas. He did not refer constitutional symptoms and his past medical history was unremarkable. On shoulder X-ray, there were osteolytic and osteoblastic lesions irregularly distributed in the metaphysis of the left humerus consistent with malignancy. Magnetic resonance imaging of the left entire humerus demonstrated a lesion in proximal humerus lesion associated with two independent lesions in distal-third shaft and distal epiphysis. Intra-medullary osteosarcoma with skip metastasis was diagnosed as first option. Chest CT and bone scan ruled out distant metastasis and high-grade conventional osteosarcoma was the results of CT-guided biopsy. Multidisciplinary team decided

management plan. Neoadjuvant multi-agent chemotherapy was administered preoperatively, with more than 95% tumour necrosis and wide margin was obtained. An entire humeral resection together the soft tissue mass was performed at surgery theatre and polyethylene total humeral endoprosthesis was implanted and covered with an aortograft mesh. Soft tissue and muscular tendons were reinserted into prosthesis holes.

Results High-grade conventional osteosarcoma and a distal-third shaft skip metastasis with 99% tumoural necrosis were confirmed. No neurovascular injuries were detected. At 1-year follow-up, he has no pain. He reported an episode of elbow subluxation that resolved spontaneously. His elbow range of motion was -20 degrees of extension and 90 degrees of flexion.

Conclusion Total humeral endoprosthetic replacement provides reliable reconstruction with preservation of a useful extremity. It provokes less artefacts in images such as MRI so it could allow to detect prompt local recurrence. It is a very recent method of reconstruction and it is needed to do long-term studies.

Infection, Tumours

EP-104

Treatment of osteoidosteoma using percutaneous bipolar radiofrequency ablation with integrated liquid cooling (OsteoCool™): a preliminary case series

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Level V

Purpose Osteoidosteomas are benign tumours with extensive night pain due to osteoid production. Radiofrequency ablation (RFA) has become a leading treatment modality, however tissue adjacent to the tumour is at risk of thermal damage. OsteoCool™ has been introduced in 2016 as a new RFA system which is able to chill the surrounding tissue along the needle shaft with circulating water in order to focus the applied heat only to the lesion. The new RFA system was used for osteoidosteomas in various bony locations. The purpose of this case series was to assess the clinical success rate and recurrence in the follow up time.

Methods 6 patients (mean age 16,6 years) with a single osteoidosteoma were treated by using the OsteoCool™ system between September 2016 and September 2017. Tumours were located at the lower extremity and lumbal spine body. The lesions were CT-guided punctured under general anaesthesia and 2 cycles of heat (target temperature 70°, ablation time depending on active tip size) were applied according to manufacturer's protocol. Postoperative pain reduction, intra-

operative complications and signs of thermal damage to adjacent tissue such as skin necrosis were documented.

Results Immediate pain reduction was observed in all 6 patients. No intraoperative complications or postoperative signs of thermal damage were reported. One patient showed prolonged wound healing due to mechanical stress at the skin entry site associated without requiring further treatment. No recurrence occurred during the follow up (mean 22,8 weeks).

Conclusion RFA with the OsteoCool™ system is comparable to established percutaneous ablation techniques. The cooling of the surrounding tissue is advantageous since high temperature are required for RFA application. Based on this case study RFA with OsteoCool™ provides a safe and effective treatment for osteoidosteoma especially in children and adolescents. Prospective cohort studies with a larger population are needed.

Spine

EP-105

Scoliosis in arthrogryphosis multiple congenita

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Level IV

Purpose Scoliosis is associated in severe forms with some syndromes, such as arthrogryphosis multiple congenita (AMC).

Methods A 10-year-old woman comes to our clinic to assess her grade of syndromic scoliosis. As past medical history, she presents AMC with complete functional upper limbs in contrast to her lower limbs, with bilateral hip dysplasia, bilateral rigid flexed knees and equinus feet. On physical examination, it is observed a left-rotated collapsing curve with right ribs touching her pelvis, hypokyphosis and lumbar hyperlordosis. On spine X-ray, on coronal plane there is a 122 degrees curve from T4 to L4, that can be modified until 78 degrees by traction test. She was admitted to hospital to multidisciplinary assessment. She presented restrictive pulmonary disease and severe malnutrition that was treated preoperatively. Halo-gravity traction (HGT) was implanted in order to progressive correction of spine deformity increasing weight until 5 kg (her current weight was 11 kg). 6 weeks after HGT start, by posterior spine approach, she is undergone T2-sacroiliac arthrodesis with Ponte's osteotomies and fixation by pedicular screws and bars.

Results Postoperative coronal T4-L4 curve was 30 degrees curve. She developed radicular pain in L5 territory so that spine CT was ordered. CT ruled out pedicular screw malposition and pain was resolved with conservative methods. At 6-months follow-up, she is happy and no pain. She presents a dehiscence of distal-third surgical wound that is closing by second intention.

Conclusion Scoliosis incidence in AMC is high and rapid progressive. Strict observation is mandatory and conservative

treatment must start as soon as possible, although it used to be resistant. If curve increases 50 degrees, surgery is indicated and HGT could be used in order to diminish complications.

Trauma

EP-106

Effect of pin configuration on outcomes of supracondylar fracture patients who had closed reduction and percutaneous pinning (CRPP)

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Level III

Purpose Supracondylar fractures that require surgery are usually treated with closed reduction and percutaneous pinning (CRPP). This paper looks at the effect of different pin configuration on surgical outcomes.

Methods This is a retrospective cohort study. Data for 418 patients from 2008 to 2013 with supracondylar fractures treated with CRPP was collected. 3 types of pin configuration were used, namely all lateral (n=42, 10.00%), 2 lateral and 1 medial pin (n=181, 43.30%), or 1 lateral and 1 medial pin (n=183, 43.78%) with 12 listed under others. Outcomes include interval loss of fracture reduction, pin migration, pin loosening, days taken for complete fracture healing, neurological deficits, and residual deformities. Univariate and multivariate analysis was performed.

Results 259 (61.96%) were male and 159 (38.04%) were females, with a mean age of 6.31 years (range 1-14, IQ range 4 years), and mean weight of 23.87kg (range 8.7-64, IQ range 9.85). The average time taken for radiological healing for 1 medial and 1 lateral pin was 45.4, 1 medial 2 lateral pin was 37.7, and 3 lateral pin was 49.9 days. We noted that pin configuration had no effect on the outcomes such as time taken to healing (p=0.88), neurovascular deficits (p=0.36) or residual deformities (p=0.34). We also noticed no significant correlation between type of construct, pin migration and loss of reduction at 1st week and 3rd month follow-up visit post CRPP, (p= 0.3206 and p=0.4559) and (p=0.8856 and p=0.07681), respectively.

Conclusion Pin configuration did not affect the surgical outcomes, suggesting that all modalities are acceptable options.

Congenital, Syndromes, Skeletal dysplasias

EP-107

Trichorhinophalangeal syndrome type 1 with unilateral ectrodactyly

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Level IV

Purpose Trichorhinophalangeal syndrome type 1 (TRPS1) is a rare skeletal dysplasia, characterized by a distinct facies, sparse hair, short stature and typically cone-shaped epiphyses of phalanges. Cognitive function is usually normal. In contrast, patients with trichorhinophalangeal syndrome type 2 (TRPS2) often have intellectual disability and exostoses/osteochondromas. TRPS1 is caused by mutations in TRPS1 located at 8q23.3 (OMIM 190350) and inheritance is autosomal dominant. Longitudinal reduction defects in the hand can be described as ulnar, central or radial. Central defects are termed ectrodactyly.

Methods We report a boy with a rare skeletal dysplasia and a congenital limb malformation combined. He has TRPS1 (trichorhinophalangeal syndrome type 1) and oligodactyly (ectrodactyly) of the left hand. He has a known pathogenic mutation in TRPS1 (c.1630C>T (p.Arg544*)) inherited from his mother. He has mild short stature and has had joint pain since early childhood. He is of normal cognition.

Results At 9 years of age, his hand radiographs showed cone-shaped epiphyses of multiple phalanges in both hands, a classic finding in TRPS1 and TRPS2. The boy also has Perthes-like changes in both hips and was treated for a calcaneovalgus deformity in both feet. The cone-shaped epiphyses are also present in the toes. The patient's left hand has three rays. Radiographically, the thumb is normal. The central ray has a bifid metacarpal bone distally and a single central broad finger. The ulnar ray is about the size of the 3rd finger on the right hand. Clinically an ulnar defect in the left hand was suspected. **Conclusion** Limb defects are sometimes found in TRPS2 but has to our knowledge not been described in TRPS1 before. Whether the oligodactyly in this patient is related to TRPS1 or is a coincidental finding is not clear.

