ABSTRACTS

# EPOS 2019 ePoster Abstracts



Trauma

**EP-001**

## Birth epiphyseolysis: visualization of "invisible" fractures and its treatment

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**Level III**

***Introduction and Objective*** The aim of the study is to systematize possible variants of birth epiphyseolysis and show their clinical and visualization signs, and also methods of treatment.
***Materials and Methods*** 22 neonates were treated. Detailed clinical evaluation and ultrasound visualization were done. X-ray and MRI was done in some cases. Clinical signs were: forced position of an affected extremity, reduction of active movements, enlargement of the injured area in circumference, presence of angular deformity. Routine cast applications, soft-cast fixation and von Rosen splinting were used for treatment. The gentle attempts of close reposition were performed in some cases.
***Results*** The localization of injures was as: distal femoral epiphysis – 9, distal humeral epiphysis – 7, proximal humeral epiphysis – 3, proximal femoral epiphysis – 2, proximal tibial epiphysis - 1 case and proximal radial epiphysis - 1 case. Typical ultrasonographic signs were:(1) true transversal translation and/or angular deviation of epiphysis (2) a little cortical fragment (≤ 2,0 mm) was detected in some cases, indicating to an osteoepiphyseolysis;(3) significant enlargement of soft tissues in the zone of epiphyseolysis (+20% or more). X-ray demonstrated the signs of dislocation in the affected zone, but it was not a real joint dislocation – it was pseudodislocation caused by epiphyseolysis.
***Conclusions*** 1. Birth epiphyseolyses occur more frequently than we supposed and have various localizations. 2. Birth epiphyseolyses have typical clinical signs (PLPV-tetrade: posture- limited motion- pain- volume+). 3. Ultrasound evaluation is a fast, simple and absolutely sufficient method of birth epiphyseolysis verification. Detection and fixation of birth epiphyseolysis is important because it decreases neonatal pain syndrome and optimizes vital functions.

Tumours

**EP-002**

## Incidental musculoskeletal findings in generation R, a population-based prospective cohort study from fetal life until adulthood

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**Level II**

***Introduction and Objective*** Generation R is a population-based prospective cohort study from fetal life until adulthood. A total of 9778 mothers with expected delivery dates between April 2002 and January 2006 were included initially. This study presents the incidental findings (IFs) on MRI of the pelvis and lower spine in this cohort.
***Materials and Methods*** At the age of 8 to 13 years a total of 5862 children were invited to undergo MRI examination. A subgroup consisting of 2763 children underwent hip MR imaging between March 2013 till November 2016. They all had an MRI (3.0T, GE) of the pelvis and lower spine with T1

and T2 coronal sequences. Al the images were analyzed by trained medical staff. All abnormalities were reviewed and classified by an experienced musculoskeletal radiologist (EO) and those with possible clinical significance by an experienced pediatric orthopedic surgeon (JB).
***Results*** At an average age of 10.2 years (range 8.6-12.9 years), 236 of the 2863 children (8.2%) had Ifs; 202 solitary bone cysts, 22 chondroid lesions, 14 Tarlov cysts, perineural cysts or meningeal diverticulae, 3 synovial cysts, 3 intraosseous hemangiomas, 3 facet cysts, 2 benign vascular malformations, 2 fibrous lesions. The following findings were found once; Perthes' disease, non-ossifying fibroma, small spinal canal, soft tissue lesion, ganglion, epidural lipomatosis and epidermoid/arachnoid cyst.
***Conclusions*** Incidental findings on MRI of the pelvis and lower spine are found in 8.2% of children in the age of 8.6 to 12.9 years in a population-based cohort study. Most common IFs are solitary bone cysts and chondroid lesions.

Knee

**EP-003**

**Systematic isolation of key parameters for estimating skeletal maturity on knee radiographs**

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**Level IV**

***Introduction and Objective*** The ability to estimate skeletal maturity using a knee radiograph would be useful in the treatment of immature ACL injuries and limb length discrepancy, but a quick, accurate and reproducible method is lacking.
***Materials and Methods*** Annual knee radiographs from 3 years before to 2 years after the chronological age associated with 90% of final height (an enhanced skeletal maturity gold standard versus peak height velocity) were analyzed in 80 children. The Pyle & Hoerr (PH) knee method was simplified into 10 femur, 9 tibia, 6 fibula, and 6 patella stages. The Roche-Wainer-Thissen (RWT) knee method was simplified from 36 to 26 parameters by removing 5 with poor definitions and 5 not relevant to the peri-pubertal age range. Greulich & Pyle (GP) hand bone age and central peak value (CPV) of the distal femur were included for comparison. After a 20-radiograph review by 2 readers, 12 of the 26 RWT parameters were omitted from further assessment based on validity and reliability cutoffs. Stepwise multiple linear regression was used to compare the methods and isolate key parameters.
***Results*** 326 knee radiographs from 41 girls (mean age 11.1 years) and 37 boys (mean age 12.9 years) were included. Regression analysis showed higher correlation using the modified RWT ($R^2$=0.925) versus baseline demographics ($R^2$=0.841), CPV ($R^2$=0.867), GP ($R^2$=0.90), and PH ($R^2$=0.904). The final optimized RWT model contained 8 parameters (2 femur, 5 tibia, 1 fibula). Compared to the correlation coefficient of RWT ($R^2$=0.925), there were minimal incremental increases by adding CPV ($R^2$=0.926), GP ($R^2$=0.928), or PH ($R^2$=0.934), suggesting redundant information by these systems.
***Conclusions*** We have systematically isolated an abbreviated skeletal maturity system using 8 discrete radiographic parameters which could potentially outperform Greulich & Pyle.

Trauma

**EP-004**

**Review of the orthopaedic management of injured children following the Manchester arena bomb blast**

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**Level IV**

***Introduction and Objective*** This study reviews the orthopaedic care of the thirteen patients who were admitted and treated at Royal Manchester Children's' Hospital following the Manchester Arena Bomb blast.
***Materials and Methods*** We included all children admitted to Royal Manchester Children's Hospital injured following the bomb blast who either suffered upper limb, lower limb or pelvic fractures, or penetrating upper or lower limb wounds. The nature of each patient's bone and soft tissue injuries, initial and definitive management, and outcome were assessed and documented. Main outcome measures were time to fracture union, time to definitive soft tissue/skin healing, and functional outcome.
***Results*** Thirteen children were admitted with orthopaedic injuries; 12 were female and mean age was 12.69. All patients had penetrating deep wounds with at least one large nut foreign body in situ, two patients suffered significant burn injury, one patient required amputation of two digits, and two patients required local flap reconstruction. There were a total of 29 upper and lower limb fractures in nine of the patients, with the majority managed without internal or external fixation. In only half of the patients all fractures showed full radiological union at 6 months follow-up. There was significant morbidity with several patients suffering long-term physical and psychological disability and one patient still in hospital.
***Conclusions*** We found that stable fractures in children secondary to blast injuries can often be appropriately managed without metalwork, and penetrating wounds can be managed without the need for skin graft/flap reconstruction. Our

study documents the severe nature of the injuries suffered by paediatric survivors of the Manchester Arena bomb blast. It highlights the demands on a trauma unit following such an event.

Trauma

**EP-005**

**Art and fractures – what children choose to express**

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**Level III**

***Introduction and Objective*** Art therapy is an established therapeutic intervention in children who have experienced serious trauma. Art also allows us to bear witness to the child's perception of their injury. We were curious about how children perceived their experiences of their fractures.
***Materials and Methods*** All children attending fracture clinics were asked to draw an aspect of their injury. No guidance was given. Children were asked to describe their picture by clinic nurses. Four independent adults (paediatric orthopaedic surgeon, paediatric nurse, adult orthopaedic surgeon and an orthopaedic registrar) independently reviewed the pictures and were asked if the pictures represented a positive or a negative experience.
***Results*** 15/42 children agreed to participate, ages <5yr and >13yr were more likely to refuse. There was 100% agreement from the adult reviewers about whether the pictures were positive or negative. Younger children (<10yr) focused on the mechanism of injury. All 'negative' pictures were in older children (>10yr). 6/15 pictures focused on the treatment of the fracture; 3/6 were negative – all of these children had operative management. 8/15 pictures focused on the mechanism of the injury, 2/18 were negative.
***Conclusions*** This study is a fascinating and simple way to examine children's emotional response to simple fractures. Adults had excellent inter-observer agreement about whether a picture was positive or negative, indicating that examination of freely-drawn artwork is a good method to look at children's emotional response to an insult. Older children are more likely to express their fracture experience as negative. All children who received operative treatment drew 'negative' pictures. We should do more to make operative management of paediatric fractures a better experience for patients.

Neuromuscular

**EP-006**

**Incidence of post-operative venous thromboembolism in children with cerebral palsy**

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**Level IV**

***Introduction and Objective*** Venous thromboembolism (VTE) is an uncommon occurrence in post pediatric orthopedic surgical procedures, rates range 0.1 to 60 per 10,000 children. The study aimed to document VTE incidence for CP patients who underwent any type of surgical procedure.
***Materials and Methods*** Retrospective study identified all CP patients age 0 to 21 years diagnosed with VTE who underwent surgical procedure at one institution from 2008 - 2017. Diagnosis codes and associated patient events were recovered from EMR and reviewed to ascertain actual VTE.
***Results*** CP surgical events were 4415 with 87 (0.019%) patients having VTE diagnosis post-surgery. Thirty-eight of 87 patients with VTE were ruled out due to lack of temporal association with any surgery. Fourteen of 49 (0.003% of total surgical events) had confirmed lower extremity (LE) VTE. Quadriplegic CP (8, 58%) most common diagnosis; GMFCS 5 (7, 50%) most common functional level. 50% of patients of 14 VTE cases were carriers of relevant hematologic defect causing hypercoagulable state; 10/14 had factor V Leiden mutation. Most common risk factor was recent cast immobilization. Of 9 locations for VTE, 7 of 14 cases (50%) occurred at the thigh. No thromboprophylactic treatments were used in this time period. Surgery associated VTE developed after LE surgery (8), spine surgery (4) and Baclofen Pump implants (2). All VTE events resolved. There were no pulmonary emboli.
***Conclusions*** Post-operative LE VTE is rare within CP. This study in which no prophylaxis was used found an incidence of 0.003%. The rate of VTE in children with CP occurrence is low, 0.003%. Based on this and no evidence of pulmonary emboli, there is no justification for routine use of any VTE prophylaxis. Careful clinical and family history should identify patients with possible genetic hypercoagulable states.

Trauma

**EP-007**

**Paediatric fracture guideline development**

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**Level III**

***Introduction and Objective*** Within the Dutch trauma community a paediatric fracture guideline was developed and presented in 2018. The guideline was developed in cooperation with a multitude of scientific societies of different medical and surgical specialties. The aim is to give clinicians a guide in treatment, to ensure a standard of care and give insight into the current evidence in paediatric fracture care.

***Materials and Methods*** A total of 8 scientific societies committed to developing this guideline in cooperation with the Knowledge Institute Federation Medical Specialists. 7 Topics were identified (proximal humeral fractures, supracondylar humeral fractures, forearm fractures, wrist fractures, femoral fractures, tibial and/or fibular fractures, ankle fractures). A PICO strategy was used, searching on Medline (OVID), Embase and the Cochrane Library. The articles were screened for study design, full text English or Dutch, age 18 yrs or less, requested outcome measurements.
***Results*** 2472 articles were selected. After screening title and abstract 253 were selected and after the appropriate selection criteria 106 articles were fully screened. Eventually 17 articles could be selected and evaluated using the GRADE criteria. A total of 121 recommendations have been postulated. Topics without sufficient evidence have been approached with a consensus meeting
***Conclusions*** The guideline is acknowledged by scientific societies from different specialties. It is a first step in standardized paediatric fracture care, avoiding misdiagnosis, incorrect treatment and insufficient follow up. Although there is marginal evidence, consensus on treating the most frequently encountered fractures was reached. The transparent approach and availability give insight in the current literature and inspires to develop further (multicenter) studies.

Tumours

**EP-008**

**Surgical margins for Ewing's sarcoma – can we afford to be less conservative?**

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**Level IV**

***Introduction and Objective*** There is no current consensus regarding optimal tumour resection margins for long bone Ewing's sarcoma. Most resection margins are based on the pre-chemotherapy T1 MRI. Current chemotherapy regimens can profoundly reduce the tumour volume and extent of oedema seen on MRI. We aimed to assess whether those based on the post-chemotherapy pre-operative imaging could achieve safe histological margins, whilst increasing the possibility of joint- or physeal-preserving surgery.
***Materials and Methods*** Retrospective analysis of nine consecutive patients treated for long bone Ewing's sarcoma was performed. The radiological tumour and tumour-bed size, and the distance to the nearest physis or joint surface on both pre- and post-chemotherapy imaging were collected. The post-operative histological measurements and the correlation to the pre-operative imaging were assessed.
***Results*** The mean longitudinal reduction in tumour size on post-chemotherapy scans was 35% of the original length [range 7.3–56.0]. Five patients would have had clear margins regardless of whether pre- or post-chemotherapy MRI was used to guide resection, and three patients would have had a resection through tumour bed (area of therapeutic response but absent viable tumour cells). In those three patients, the average discrepancy between pre-operative imaging and histological margin was 1.7cm [range 0.8-2.9] for pre-chemotherapy and 1.8cm [range 1.3-2.9] for post-chemotherapy imaging respectively. One patient had clear margins on the basis of the pre-chemotherapy MRI, but would have breached the tumour bed by 0.6cm based on the post-chemotherapy MRI.
***Conclusions*** Pre-operative planning based on post-chemotherapy imaging may allow narrower resection margins. However, our results highlight potential risks of breaching the tumour bed when these margins are used.

Tumours

**EP-009**

**Long term follow-up of eosinophilic granulomas of the axial and appendicular skeleton managed only with biopsy**

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**Level IV**

***Introduction and Objective*** In this study, long term clinical and radiological follow-up results of eosinophilic granulomas of the axial and appendicular skeleton managed only with biopsy were evaluated.
***Materials and Methods*** Fifty-six children [34 males, 22 female; average age 9(3.5-17) years] with eosinophilic granulomas of the axial and appendicular skeleton were followed after biopsy. The patients with a solitary bone lesion were included. Plain radiographs and, when required, MRI and CT scans were used for evaluation. Involved bones were femur (17), tibia (5), humerus (7), ulna (1), radius (2), pelvis (13), scapula (3), clavicle (2) and vertebra (6). After confirming the diagnosis by a closed tru-cut trochar biopsy, no further surgical intervention was performed. Clinical follow-up was done with preoperative and postoperative MSTS and VAS scores. Healing process was followed with periodic radiographs. Average follow-up was 62 (26-150) months.
***Results*** Average preoperative MSTS score was 45% (30-56.6%), whereas postoperative 6., 12. and 24. month scores were measured as 76% (70-83.3%), 88% (73.3-93.3%) and 94% (86.6-100%) respectively. Average VAS score which was 8.4 (6-10) preoperatively had a tendency to decrease postoperatively, and measured as 3.5 (2-5), 2.2 (1-3.5) and 1.1 (0-2) at 3., 6. and 12. month, respectively. Even though majority of the lesions demonstrated complete radiographic healing within 24 months, healing process extended to 36 months on flat bones. Complete restoration of the vertebral body height was achieved within 5 years. All of the lesions regressed following biopsy. No recurrence, limb-length discrepancy or deformity observed.
***Conclusions*** Solitary eosinophilic granulomas have a spontaneous healing potential and confirming the diagnosis by

a biopsy is enough to get good functional and radiological results.

Upper Extremity

**EP-010**

**Solitary closing wedge corrective osteotomy in camptodactyly patients**

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**Level III**

***Introduction and Objective*** Although camptodactyly is common congenital anomaly affecting about 1 to 2 % of the general population, treatment option is still controversial. Complicated surgical techniques from simple release of FDS to multistep soft tissue reconstruction were introduced however, simple solitary closing wedge corrective osteotomy on proximal phalanx can easily improve finger deformity and function.
***Materials and Methods*** We analyzed 52 fingers in 27 patients. All patients underwent the surgical treatment using solitary closing wedge corrective osteotomy with one or two Kirschner wires from 2002 to 2017. A single orthopedic surgeon performed surgical treatments.
***Results*** Among 27 patients, seven patients (25.9%) were arthrogryposis multiplex congenita and 1 patient was tunnel syndrome. 15 patients (55.6%) had single digit camptodactyly, 7patient (25.9%) 2 digits. 5 patients (18.5%) had multidigit camptodactyly bilaterally. Average age on surgery was 5 years and 8 months (from 2 to 16 years). 2 patients got shortening osteotomy with wedge correction. Additional soft tissue release with Z-plasty was performed in only 5 patients and 2 of them were AMC and other 3 were older patients whose average age was 15 years old. Average preoperative angle of flexion contracture of PIP joint was 70.5 degree (range 35-120°) and postoperative became 15.4 degree (range 1.2-38°)
***Conclusions*** Complicated stepwise surgical technique was introduced in many articles for camptodactyly treatment however this could be technical demanding and there is no long-term analysis for the re-contracture from the invasive joint reconstruction surgery. Closing wedge corrective osteotomy is relatively easy to control the correction angle and it can prevent the scar contracture and adhesion without any additional damage to the joint.

Upper Extremity

**EP-011**

**Lateral-only pinning of type-3 supracondylar humerus fractures: a population-based study of redisplacement and surgical technique deficiencies**

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**Level III**

***Introduction and Objective*** The recommended treatment of Gartland type-3 supracondylar humerus fractures (SCHF) is reduction and surgical fixation: Lateral-only pinning is superior in avoiding ulnar nerve injury but less stable than medial and lateral pins. Poor stability is suggested to be a consequence of inappropriate surgical technique. Therefore, we analyzed redisplacement and technical deficiencies of lateral-only pinning.
***Materials and Methods*** All children (aged <16 years) in a geographic area with distal humerus fracture were first included (N=861) and their all radiographs were re-evaluated. Out of 565 SCHF 34.5% were of type-3 and 24 treated by lateral-only pinning, comprising the study population. Loss of reduction in the follow-up was the main outcome while close characteristics of primary reduction and surgical technique were the explanatory variables.
***Results*** One in three of the fractures (29.2%, 95% CI 12.6—51.1%) redisplaced during the follow-up. Lateral-only pins that crossed at the fracture line associated with failure (87.5%), compared with none among the cases with appropriate pin configuration (difference 87.5%, 95% CI 52.1%—97.8%, P<0.001). Low distance <5mm between the entry-points of the pins associated with redisplacement (80% vs. 15.8%, diff. 64.2%, 95% CI 16.1—86.9%, P=0.008). Open reduction (P=0.07), insufficient <4mm bone contact (P=0.28), mono-cortical pins (P=0.569), low diverging angle (P=0.13) or even parallel pins (P=1.0), residual postoperative coronal plane translation (P=1.0), > 5° changed Bauman angle (P=0.11) or rotational displacement (P=0.25) did not associate with unstability.
***Conclusions*** Lateral-only pinning resulted in good stability in most (70.8%) patients with type-3 SCHF. However, crossing the pins at the fracture and introducing them with low separation associated with redisplacement.

Congenital, Syndromes, Skeletal Dysplasias

**EP-012**

**Proximal tibia vara is a hidden deformity in a subset of patients with congenital posteromedial bowing of the tibia**

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**Level IV**

***Introduction and Objective*** Congenital posteromedial bowing (CPB) presents with a diaphyseal bow that slowly improves and progressive leg length discrepancy (LLD). We describe a

subset of patients with CPB who also have a compensatory proximal tibial varus (PTV) deformity.
***Materials and Methods*** We conducted a retrospective review of children with CPB at our institution from 2007 until 2017. Full length anteroposterior and lateral views of the tibia/fibula were analyzed.
***Results*** We identified two patterns: double-level deformity (proximal varus, diaphyseal valgus) and single-level diaphyseal valgus. Both had recurvatum of the diaphyseal segment. Nine of 18 patients diagnosed with CPB had not yet been recommended for surgery, and none of those had PTV deformity. Average age of remaining 9 patients who had been recommended for surgery was 6.7 years (range, 1.4-17.5 years). Three of the 9 patients also had PTV deformity (10°, 10°, and 9°). Two of the three patients underwent double-level osteotomies with gradual deformity correction. The third patient is planning to undergo proximal tibial guided growth. Average oblique plane posteromedial deformity of the three patients with PTV was 28.9° (standard deviation [SD] 9.2°) and for the six patients without PTV was 25.3° (SD 10.6°). Average LLD of three patients with PTV was 5.5 cm (SD 2.6 cm) and for six patients without PTV was 3.8 cm (SD 1.2 cm).
***Conclusions*** Children with CPB of the tibia should be evaluated for PTV so that this "hidden" deformity can be addressed when developing a treatment plan. The treatment plan can then include PTV treatment (double-level osteotomy or combined osteotomy plus guided growth strategy). Failure to recognize PTV deformity may lead to residual mechanical axis deviation (varus) after correcting the posteromedial bow.

Congenital, Syndromes, Skeletal Dysplasias

**EP-013**

**Recessive multiple epiphyseal dysplasia in differential diagnosis of juvenile arthritis**

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**Level III**

***Introduction and Objective*** Juvenile arthritis (JA) is an umbrella-term describing a heterogeneous group of diseases characterized by chronic synovitis. Several skeletal dysplasias can lead to secondary arthritis and should be considered in the differential diagnostics of JA. Some children with recessive multiple epyphyseal dysplasia (rMED) receive unnecessary treatment when unproperly diagnosed with JA. Goa: to improve the diagnostics of rMED in population of children with symptoms of arthritis.
***Materials and Methods*** Retrospective review of the charts, laboratory data and radiological studies of 52 children primarily diagnosed with JA was performed. In 22 patients diagnosis of rMED was later done, in 30 patients JA was confirmed.
***Results*** 1. Children with rMED had less morning stiffness. Bilateral painless joint contractures and axial deformation of the lower limbs were main clinical finding in children with rMED. 2. Radiological findings included overgrowth of metaepiphyses and local osteoporosis, errosive chondral lesions. Symmetric flattening of the epiphyses of metacarpals and phalanxes, femoral heads, knees and feet, double-layered patella were x-ray hallmarks of rMED. 3. Ultrasound and MRI data signs of synovitis were detected in most of children. Patients with rMED had secondary synovitis due to chronic damage and degeneration of the primarily defective articular hyaline cartilage (erosive-like chondrolysis). 4. Response to anti-inflammatory therapy was not definitive sign of JA and more likely reflected non-specific inflammatory mechanisms recruited in pathogenesis of both conditions.
***Conclusions*** This comparative study revealed some clinical and instrumental characteristics of rMED which mimic JA. Sequence of SLC26A2 gene should be recommended in cases with the non-typical clinical and radiographic findings in children with JA.

Foot

**EP-014**

**Outcomes of the calcaneo-stop procedure for the treatment of juvenile flatfoot in young athletes**

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**Level IV**

***Introduction and Objective*** Flexible flatfoot (FFF) is a widespread condition in juvenile patients. If symptomatic, FFF can require surgical treatment. The calcaneo-stop procedure (CSP) has shown excellent clinical and radiographic outcomes and low rates of complications. The aim of the present study was to assess the sport practice of young athletes affected by FFF having undergone the CSP
***Materials and Methods*** Between 2008 and 2016, 68 sport practitioners were bilaterally treated by the CPS, for a total of 136 FFF cases. Clinical evaluation, including the American Orthopedic Foot and Ankle Score (AOFAS), the Yoo et al score and The Foot & Ankle Disability Index (FADI) and FADI Sport scores were assessed. Radiographic evaluation was based on measurement of talar declination, Costa-Bertani's angle and calcaneal pitch.
***Results*** Mean follow-up was 57.6 months (sd 16.8). The AOFAS score mean increased from 79.3 (sd 5.7) to 97.3 (sd 4.5) three years after surgery. The Yoo score improved from 3.1 (sd 1.0) preoperatively to 11.7 (sd 0.6) three years after surgery. The FADI Sport subscale mean improved from 74.1 (sd 10.4) preoperatively to 95.9 (sd 4.9) three years after surgery. Costa-Bertani's angle decreased from 156.1° (sd 4.2°) to 135.8° (sd 7.3°) at three years postoperatively; mean talar declination angle decreased from 44.2° (sd 6.3°) to 30.6° (sd 3.2°) at three years postoperatively and mean calcaneal

pitch increased from 12.6° (sd 2.3°) to 16.3° (sd 1.3°) at three years postoperatively.
***Conclusions*** Adolescent patients who underwent the CPS reported satisfactory outcomes in terms of clinical and radiological evaluations. Moreover, our results showed an improvement of sport activity levels, with patients recovering sports activity within three months of surgery and without limitation in the execution of preferred activities.

Knee

**EP-015**

**Guided growth of the tibia for recurvatum**

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**Level III**

***Introduction and Objective*** Genu recurvatum may result from growth disturbance of the distal femur or proximal tibia. Nonoperative management, including bracing, is futile and heretofore, corrective osteotomy has been the only surgical option. Our purpose is to describe the, strategy, technique, and preliminary results of sagittal guided growth as a definitive management for tibial recurvatum.
***Materials and Methods*** There were 3 boys (one bilateral) and one girl with a total of 5 deformities, managed by means of tethering of the posterior proximal tibial physis with a tension band plate. Standard radiographs, obtained preoperatively and at follow-up, included a standing AP of the legs, noting limb lengths and the mechanical axis. We also obtained standing lateral views of each knee in maximal extension, to measure and compare the posterior proximal tibial angle (PPTA).
***Results*** There were no surgical or postoperative complications. The preoperative PPTA ranged from 106–117 degrees and averaged 84.0 at follow-up. Each sagittal deformity corrected to a normal range in an average of 17 months (range of 7 to 24 months). The patient with Hurler's Syndrome developed unilateral, recurrent recurvatum, culminating in recent percutaneous reinsertion of the metaphyseal screw. All patients will be followed until skeletal maturity. The limb lengths remained equal at follow-up and the mechanical axes neutral, with incidental coronal guided growth, as needed, to maintain this.
***Conclusions*** Children with genu recurvatum manifest insidious onset of symptoms that persist and often progress. Guided growth of the posterior proximal tibia is a safe and effective means of correcting this deformity, without having to resort to osteotomy. Upon correction, the metaphyseal screw can be removed percutaneously and reinserted in the event of recurrent deformity.

Knee

**EP-016**

**Anterior cruciate and medial collateral ligament footprint anatomy in skeletally immature cadaver knees: avoiding physeal injury and growth disturbance**

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**Level III**

***Introduction and Objective*** Anterior cruciate ligament (ACL) and medial collateral ligament (MCL) injuries in skeletally immature patients are increasingly recognized and surgically treated. However, the relationship between ligamentous footprint anatomy and the physes are not clearly defined. Even with physeal-sparing approaches, reports of growth disturbance appear in the literature. The purpose of this study was to define the footprint anatomy of the ACL and MCL as it relates to the physis.
***Materials and Methods*** Twenty-nine pediatric knees from human cadaver specimens were dissected and divided into two groups: Group A (2-5 years), and Group B (7-11 years). Pins were placed to mark the femoral and tibial ligamentous attachments. CT scans were used to measure the distance from the center of the ligament footprints to the respective distal femoral and proximal tibial physes.
***Results*** The following is reported for Groups A and B, respectively. Median distance from the:
-ACL femoral epiphyseal origin to the distal femoral physis was 0.30cm (interquartile range (IQR), 0.20cm-0.50cm) and 0.70cm (IQR, 0.45cm-0.90cm)
-ACL epiphyseal tibial insertion to the proximal tibial physis was 1.50cm (IQR, 1.40cm-1.60cm) and 1.80cm (IQR, 1.60cm-1.85cm)
-MCL femoral origin on the epiphysis to the distal femoral physis was 1.20cm (IQR, 1.00cm-1.20cm) and 0.85cm (IQR, 0.63cm-1.00cm)
-MCL insertion on the tibial metaphysis to the tibial physis was 3.05cm (IQR, 2.63cm-3.30cm) and 4.80cm (IQR, 3.90cm-5.10cm).
***Conclusions*** Cadaveric dissection and CT scanning clearly defines the locations of the ACL and MCL with respect to their corresponding physes. This information helps surgeons minimize physeal injury and significant growth disturbance during ligament repair/reconstruction procedures in skeletally immature patients.

Knee

**EP-017**

**Osteochondral fractures (OCFS) accompanying acute patellar dislocation (APD) in adolescents - midterm results of open reduction, internal fixation (ORIF)**

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**Level III**

***Introduction and Objective*** OCFs occur in 25 % APD, posing risk of early joint deterioration if left untreated. Postulated treatment is anatomical reposition and stable fixation, however paucity of data on results of this surgical approach exists. The aim is to report midterm results of the OCF ORIF in adolescents.
***Materials and Methods*** 42 OCFs (24 patellar (PAT), 18 from lat. femoral condyle (LFC)) in 40 patients, aged 14,4 y on av. were treated by ORIF in the years 2004 - 1015. At the last FU clinical data were collected, KOOS questionnaire completed, the level of sport participation in comparison to preinjury period determined, as well as patient's satisfaction rate (1-10). The recurrence of patellar instability, if had occurred postoperatively, was noted. 35/40 had MRI ordered to assess the OCF incorporation and the cartilage status at the fracture site. The following variables were tested to influence the outcome: OCF localization (PAT vs LFC), length of FU, recurrence of patellar dislocation (RPD) in the FU period, patellar instability at the last FU.
***Results*** Mean FU was 76 months. Overall good results were achieved (KOOS 91.3 (general), 90 (symptoms), 94.9 (pain), 96.7 (ADL), 84.4 (sports), 71.2 (QoL). Satisfaction rate level was 8.44. 25% of patients had knee function restrictions precluding return to preinjury activity level and 30% had some patellar instability at the time of last FU. OCF localization had no impact on final outcome, neither the length of FU. RPD during the FU period, as well as patellar instability at the last FU negatively impacted outcome. On MRI all OCFs healed; cartilage changes at the fx site were noticeable in most of patients.
***Conclusions*** OCF ORIF after patellar dislocation yields good midterm outcomes. Recurrence of dislocation or persistent patellar instability decrease patients QoL and prevent return to sport.

Upper Extremity

**EP-018**

**Variation amongst surgeons when treating fifth metacarpal neck fractures in the pediatric population**

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**Level II**

***Introduction and Objective*** Fifth metacarpal neck fractures are common fractures affecting the pediatric population. However, no true treatments standardization exists. The purpose of this study was to determine if variation exists amongst surgeons when treating pediatric fifth metacarpal neck fractures and which factors influenced this variation.
***Materials and Methods*** Twenty-five sets of pediatric fifth metacarpal neck fractures images 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 marking 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 sex and age. The images, along with a brief demographic survey, were evaluated by 25 surgeons. A mixed effects model was performed, with the respondent as the random effect, to determine which factors were most associated with a decision to operate was performed.
***Results*** The factors found to be significantly associated with a surgeon's decision to operate were age and angulation. Patient sex, cast status, and image angulation marking 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 ≥55° and ≥47°, 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.
***Conclusions*** Treatment of fifth metacarpal neck fractures in the pediatric 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.

Basic Science

**EP-019**

**Retrograde femoral nailing through an open physis does not impair growth in pigs**

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**Level III**

***Introduction and Objective*** The use of retrograde femoral intramedullary nails in children for deformity correction is controversial. It is unknown if the injury to the central part of the growth plate results in premature bony union, leading to limb deformities or discrepancies. The aim of this study is to asses physeal healing and bone growth after insertion of a retrograde femoral nail in a skeletally immature experimental porcine model.
***Materials and Methods*** Ten immature pigs were included in the study. One leg was randomised for operation with a retrograde femoral nail (diameter 10.5 mm), whilst the non-operated contralateral remained as control. All nails were inserted centrally in coronal and sagittal plane under fluorescence, and the nails spanned the physis. The nails were removed at 8 weeks. All animals underwent MRI at baseline (pre-operatively), 8 weeks (after nail removal) and 16 weeks (before euthanasia). Femoral bone length was measured at 5

sites (anterior, posterior, central, lateral and medial) using 3d T1-weighted MRI. Growth difference was calculated after 8 weeks (growth with nail) and 16 weeks (growth without nail). Corresponding 95% confidence intervals were calculated. Operated limb was compared to the non-operated. Tissue was harvested for histology.
***Results*** No differences in axial growth were observed between operated and non-operated sides. Mean growth difference was 0,61 mm [-0,78;2,01] whilst the nail was inserted into the bone and 0,72 mm [-1,04;1,65] after nail removal. Furthermore, no signs of angular bone deformities were found when comparing operated side to non-operated side. No premature bony healing at the physis occurred.
***Conclusions*** The insertion of a retrograde femoral nail through the centre of an open physis might be a safe procedure with no growth arrest.

Congenital, Syndromes, Skeletal Dysplasias

**EP-020**

**Outcomes of spinal accessory to suprascapular nerve transfers for neonatal brachial plexus palsy: a multi-center study**

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**Level II**

***Introduction and Objective*** Brachial Plexus Birth Injury (BPBI) affects approximately 1.5 children per 1000 live births in the United State. Isolated Spinal accessory to Suprascapular nerve transfer (SAN-SSN) for shoulder function augmentation has gained popularity due to numerous advantages. We aimed to describe the shoulder function recovery of 47 patients that were operated at three medical centers.
***Materials and Methods*** We retrospectively reviewed the cases of 47 patients at three institutions who had undergone a SAN-SSN transfer after BPBI. Inclusion criteria were patients with BPBI who underwent a solitary SAN-SSN transfer and who had both preoperative and minimum 36 months postoperative Active Movement Scale (AMS) scores. Patients for whom the primary surgery involved tendon transfers were excluded. The primary outcome measures were the AMS scores for shoulder abduction, forward flexion and external rotation and secondary outcomes included the need for further shoulder surgery to improve function.
***Results*** 39 (83%) patients obtained functional shoulder motion (AMS≥6) following surgery, with 22 (46.8%) patient obtaining full recovery of shoulder function against gravity (AMS≥7). 40 (74%) patients did not proceed to further tendon transfers or corrective osteotomies to augment shoulder function. The anterior and posterior approaches were both found to be effective for isolated SAN-SSN in BPBI ($P>0.05$).
***Conclusions*** SAN-SSN transfers were able to recover functional shoulder motion in BPBI and prevent tendon transfer procedures and corrective osteotomies. Outcomes continue to improve throughout the first three postoperative years, and this time-point should be used as a benchmark for analyzing the results of this procedure.

Congenital, Syndromes, Skeletal Dysplasias

**EP-021**

**Surgical hip reconstruction in Aitken type A and B PFFD**

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**Level III**

***Introduction and Objective*** We report on results of valgus, shortening osteotomy hip reconstruction in children with Aitken type A & B PFFD.
***Materials and Methods*** All patients with the diagnosis of PFFD seen in our institution in the past 20 years were reviewed and all the patients with Aitken type A&B, who had surgical reconstruction and at least 2 year follow up were included in the study. 12 patients fulfilled this criteria. All patients underwent valgus, shortening, derotation osteotomy with a goal of at least 130 degrees of valgus neck shaft angle. Seven patients were followed to skeletal maturity with the remaining patients being followed for 2 1/2y, 4y, 4y, 6y and 8y respectively.
***Results*** All patients underwent complication free index operation. However, most patients required more than one operation as recurrence of varus deformity was quite frequent. The younger the age at the first surgery, the higher the risk of recurrence. Final neck shaft angle averaged 129 degrees. All patients were free of pain at follow up and all rotationplasty patients were able to use a thigh lacer prosthesis rather than ischial bearing one attesting to functionally successful reconstruction.
***Conclusions*** Valgus, shortening osteotomy of PFFD hip does seem to accomplish the stated goal of painless, anatomically sound hip joint with improved gait mechanics and prosthetic fitting. It however comes at a price of frequently multiple operations particularly so if the index surgery is performed in a very young child. Additional benefit of the procedure is an opportunity for final rotational and length adjustment in rotationplasty patients.

Congenital, Syndromes, Skeletal Dysplasias

**EP-022**

**Sequential methods of correction deformities of the lower extremities of patients with congenital pseudarthrosis of tibia after achieved union**

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**Level II**

***Introduction and Objective*** The aim of the study was to evaluate the results of the correction of deformities of the tibia in patients with congenital pseudarthrosis of tibia after achieved union.
***Materials and Methods*** We performed analysis of treatment of 28 patients with congenital pseudarthrosis of tibia (CPT) after achieved union, which were observed in the department of the Turner Scientific Research Institute from 2013 to 2018 years. In our research we used teleradiographs of the lower limbs in two standard projections, computed tomography of the lower limbs, and preliminary planning of deformity correction with using specialized software (TraumaCad, Boneninja).
***Results*** Accuracy of correction of the deformity is between seventy-one percent and hundred per cent of the respective corners. Fixation index were 63 days/cm – 95 days/cm and depended from age of child. Final correction of shortening is not always possible to achieve in a single surgery, and therefore these patients performed two or three operations to restore limb length.
***Conclusions*** Two-level osteotomies of the lower legs, excluding the zone of consolidated pseudarthosis of patients with CPT, correct the diaphyseal deformities of tibia and eliminate the inequality of the lower extremities. The revealed secondary deformities of the lower legs after removing of external fixation indicated for functional impairment of the growth plates of the tibia in patients with CPT.

Congenital, Syndromes, Skeletal Dysplasias

**EP-023**

**Variations in arterial pedal circulation in idiopathic congenital talipes equinovarus (CTEV): a systematic review**

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**Level III**

***Introduction and Objective*** Variations in pedal circulation in CTEV are well documented. The aim of this review was to identify the most common aberrancies in arterial pedal circulation in CTEV and to determine the relevance of this for clinical practice.
***Materials and Methods*** The review was registered on PROSPERO and was carried out according to PRISMA guidelines by two independent reviewers. Studies were identified that reported variations in pedal circulation in idiopathic CTEV. Papers that studied non-idiopathic CTEV and those not published in English were excluded. Data extracted included patient demographics, imaging modalities and findings.
***Results*** A total of fourteen papers were identified, including 192 patients, aged between 0 – 13.5 years, with 279 clubfeet at various stages in their treatment. Imaging modalities included arteriography (n=5), Doppler ultrasound (n=5), multiple resonance angiography (n=2), and direct visualisation intra-operatively (n=2). Dorsalis pedis (DP) was most frequently reported as absent (21.5%), and the anterior tibial artery (ATA) was most frequently reported as hypoplastic (18.3%). Where reported (n=36 feet), 61% of patients were noted to have a dominant supply from the posterior tibial artery (PTA).
***Conclusions*** The most common variation in pedal circulation in CTEV is diminished supply from ATA and DP, although there are documented aberrancies in all of the vessels supplying the foot. There is a reported risk of vascular injury to the PTA during operative procedures for clubfoot, leading to necrosis and amputation. Further prospective work is needed to assess the feasibility and benefit of routinely delineating pedal anatomy prior to operative intervention in CTEV, and choice of imaging modality.

Congenital, Syndromes, Skeletal Dysplasias

**EP-024**

**Role of sagittal boney alignment in development of genu recurvatum in children and adolescents with achondroplasia**

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**Level IV**

***Introduction and Objective*** Genu recurvatum is a common condition in children and adolescents with achondroplasia. The cause can be osseous, ligamentous and mixed. The purpose of this study was to determine the contribution of posterior distal femoral angle (PDFA) and posterior proximal tibial angle (PPTA) in young patients with achondroplasia.
***Materials and Methods*** We reviewed 106 lateral full-length lower extremity radiographs of 53 patients with achondroplasia. We compared the mean PDFA and PPTA of norms found in the literature. Paired t-test was used to determine statistical significance between the two groups. Pearson's correlation coefficient was used to correlate degree of deformity and age.
***Results*** The mean age of patients was 10. The overall mean right PDFA was 97 (±8) degrees and mean left PDFA was 97 (±7) degrees. The overall mean right PPTA was 89(±6) degrees and mean left PPTA was 88 (±6) degrees. There was no statistically significant difference between the left and right side ($p>.05$). The right PDFA, right PPTA. The difference between the achondroplasia PDFA and reported normal PDFA was 15 (±8) degrees and the difference between the achondroplasia PPTA and reported normal PPTA was 8 (±6) degrees. We compared all the differences and found the PDFA difference was significantly higher than the PPTA differences ($p<.001$). The Pearson correlation coefficient did not find a significant correlation between age and sagittal measurements ($p>.05$).

***Conclusions*** The distal femur and proximal tibia both contribute to the genu recurvatum seen in patients with achondroplasia. The deformity of the distal femur appears to contribute more to the recurvatum then the proximal tibia. We found no statistically significant difference when comparing the right and left sides.

Congenital, Syndromes, Skeletal Dysplasias

**EP-025**

**Indications for femur lengthening with a distraction nail in children**

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**Level IV**

***Introduction and Objective*** Limb length discrepancy in children is treated until now conservatively or by callus distraction using external fixation. Fully implantable systems are used only after maturity. What are indications to use fully implantable systems at the femur even in children?
***Materials and Methods*** In 20 patients (11f, 9m) with the medium age of 11.8 years (8-15) fully implantable distraction nails were used at the femur in a special minimal invasive technique to correct a limb length discrepancy of >6cm. In 5 cases a relevant deformity was corrected in the same surgery. In all cases a final step of lengthening was planned at the femur and at the tibia with fully implantable devices as well at maturity.
***Results*** In 19 cases the goal of lengthening was achieved without any complication. In one case of proximal femoral deficiency lengthening had to be stopped because of increasing tendency of knee joint luxation. Bone formation occurred circular around the nail in all cases. Full load bearing was possible in the average after 2.2 days/mm. No technical problems occur. 11 patients had a temporarily decreased range of motion during lengthening which was recurrent completely. In one case growth irritation in the lateral X-ray was observed which was corrected at the final step. At the end of treatment functional and cosmetic result was perfect in all 19 cases.
***Conclusions*** Fully implantable motorized distraction nails are a favorable option at the femur even for children older than 10 years to correct limb length discrepancy of more than 6cm. The treatment has a low pain level, is comfortable and nearly no scars are visible. At the tibia there is no experience up to now.

Congenital, Syndromes, Skeletal Dysplasias

**EP-026**

**Classification and treatment of ankle valgus in MHE patients**

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**Level III**

***Introduction and Objective*** Ankle deformities are common in patients with multiple hereditary exostoses (MHE). The aim of our study is to classify the MHE ankle in order to provide the appropriate treatments.
***Materials and Methods*** We retrospectively analyzed MHE patients, excluding previous ankle surgeries and/or congenital limb deficiencies. We analyzed radiographs to determine the osteochondroma location and morphology, lateral distal tibial angle (aLDTA), magnitude of ankle syndesmosis disruption (ASD) and level of the fibular physis or scar to the plafond. T-test was used to compare the groups with each other.
***Results*** In 102 ankles, the incidence of the valgus deformity was 65%. We located 93% of the osteochondromas in the distal metaphyseal region between the tibia and fibula. The group with distal tibial valgus had a higher mean ASD (12.8 ± 7.9 mm vs. 6.4 ± 6.3 mm, $p < .001$), and osteochondromas that were larger and closer to the ankle joint ($p < .001$). Patients with pure ankle valgus were treated with medial hemiepiphyseodesis, or a varus osteotomy in the skeletally mature. A short fibula with dynamic valgus was treated with excision of the interosseous osteochondroma taking down of the syndesmosis and selective shortening of the distal tibia with varus if needed. Five ankles treated with hemiepiphyseodesis were converted to a shortening osteotomy due to failure to correct dynamic valgus and/or progressive ASD. All ankles treated with the shortening osteotomy achieved a stable mortise and correction of valgus.
***Conclusions*** Patients who have distal tibial valgus have larger osteochondromas, more syndesmosis disruption, and osteochondromas closer to the ankle joint. A new procedure in the treatment of ankle valgus with a short fibula was described, which resulted in stable mortis and correction of valgus in all ankles treated.

DDH

**EP-027**

**Dega transiliac osteotomy in treatment of developmental dysplasia of the hip (DDH): systematic review of the literature following the PRISMA guidelines**

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**Level III**

***Introduction and Objective*** To clarify the current status of Dega transiliac osteotomy in treatment of DDH, we carried out a systematic review of the literature. Retrospective studies that reported patient outcomes were identified.
***Materials and Methods*** We searched for articles published from 1951 to 2018 in databases MEDLINE, ClinicalKey (Elsevier), Pubmed and Cochrane Library (keywords: Dega, Dega osteotomy, Dega acetabuloplasty, Dega transiliac, Dega acetabular). Additional manual search of the reference lists of reviewed articles was carried out.

***Results*** The total of 306 retrospective papers were identified of which 25 met the inclusion criteria. 20 of 25 papers (647 hips) reported the difference in pre- and postoperative acetabular index (AI) value. 16 of aforementioned reported the average AI value less than or equal to 20 degrees at the end of treatment. 15 of 25 articles (491 hips) measured center-edge angle (CEA) after surgery and reported the average values greater than or equal to 20 degrees. 12 of 25 articles analyzed the hips according to Severin classification. 82,2 % of 443 joints were classified as Severin class I or II. 10 papers (555 hips) quantified the clinical result of treatment according to McKay/Berkeley or other criteria. 85,4 % of hips got a good or very good clinical result at the end of the observation period. The percentage of the avascular necrosis (AVN) of femoral head was 18,9 % (19 papers, 834 hips). 15 authors published the cumulative percentage of reoperations that was as low as 5,7 %.
***Conclusions*** Dega pelvic osteotomy is a method of treatment that ensure adequate correction of radiological joint parameters in DDH and facilitate a good clinical result. The AVN and reoperation risk is relatively low.

Foot

**EP-028**

**20 years of experience with French functional method for congenital clubfoot: advantages and limits**

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**Level III**

***Introduction and Objective*** Since more than 20 years, conservative treatment for Congenital clubfoot (CCF), especially the Ponseti method, has showed the advantage on early surgical approach but also on late presentation case. Another conservative method, developed in France since 1950, the Functional Method (FFM) is presented.
***Materials and Methods*** Since 1993,175 children (230 clubfeet) were treated with FFM. FFM used at our Institution, is based on the "Saint Vincent de Paul" protocol from Paris (France). An evaluation at walking age is proposed. Ghanem and Seringe score is used after the age of five. Since 2011, gait analysis has been proposed to complete the long-term evaluation.
***Results*** Compliance was significantly higher than with the Ponseti method (85%). Less than 15% of the feet, need surgery. Achilleus tenotomy is less systematic (30%). At the last follow up, 70% of the children had good to very good result without major residual deformity. 7% of the children required a later surgery either for recurrence, or for major residual deformity.
***Conclusions*** FFM is an interesting approach for treating clubfeet, especially concerning rigorous and modularity of splinting system. Compliance represent a significative advantage compared to the Ponseti method. However, it requires a well-trained physical therapist team.
***Significance*** FFM represents an alternative to the Ponseti method for conservative treatment of clubfoot. However comparative study needs to be done, especially regarding the compliance and the cost of those two methods.

Foot

**EP-029**

**Clubfoot revisited - a neuromuscular disease**

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**Level III**

***Introduction and Objective*** The Ponseti casting and post-correction splinting technique have dramatically improved the management of rigid club foot deformity. Relapses requiring surgery do however, occur. The records of 110 patients at the Club Foot Clinic at NYU were reviewed. At a mean follow-up of 5.9 years, 34 required surgery before age five. Most underwent a rebalancing tibialis anterior tendon transfer. This large number of relapses suggests the presence of an underlying muscle imbalance. The concept that the fundamental pathology in rigid club foot is neuromuscular was first postulated over twenty years ago and examined in the laboratory setting.
***Materials and Methods*** In a definitive study, 90 muscle biopsies, mainly from the posteromedial muscles, were obtained at surgical correction of 13 club foot patients. All were examined ultrastructurally. Forty-eight biopsies in nine of these patients were studied using enzyme specific histochemical stains at the light microscopic level. Neuromuscular junctions were isolated in the latter group.
***Results*** Consistent ultrastructural abnormalities were observed in all specimens. Histochemistry revealed a dominant Type 1 fiber population and Type 1 fiber grouping. A correlated increase in Type 1 neuromuscular junctions occurred in these areas.
***Conclusions*** Since these changes are recognized as being neurologically determined, a neuromuscular abnormality is considered to be significant in the etiology and pathology of club foot. Clinically, an ongoing neuromuscular imbalance is clearly present. Even after full correction has been achieved, the potential for relapse is ever present. Careful long-term follow-up of club foot patients is essential. A better and more prolonged use of appropriate night splinting may limit relapse.

Hip

**EP-030**

**Acetabular dysplasia associated with slipped capital femoral epiphysis – early experience with periacetabular osteotomy in the SCFE population**

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**Level IV**

***Introduction and Objective*** A small group of patients with slipped capital femoral epiphysis (SCFE) subsequently developed acetabular dysplasia severe enough to require Bernese periacetabular osteotomy (PAO). We sought to describe their acetabular morphology, radiographic and clinical outcomes before and after PAO.
***Materials and Methods*** A search of our SCFE database revealed 649 patients out of which 6 patients (9 hips) had undergone PAO to correct their dysplasia. One patient (one hip) had inadequate pre-operative imaging and was not included. There were four females and one male. Mean age at SCFE diagnosis was 11 y (range 9 to 12). There were three moderate and four mild SCFE. Two patients had bilateral PAO. We assessed patients radiographically (lateral center-edge angle-LCEA, anterior-center edge angle-ACEA and Tonnis angle) and by outcome measures (Harris hip score and UCLA activity score).
***Results*** Mean age at PAO was 17 y (range 16 to 18). Mean duration between SCFE diagnosis and PAO was 6 y (range 4 to 9). LCEA values of the involved hip at onset of SCFE, just prior to PAO and immediately post PAO were 21°, 11° and 31° respectively. ACEA values of the involved hip at onset of SCFE could not be assessed due to lack of false profile view; however, just prior to the PAO and immediately post PAO, mean ACEA was 7° and 30° respectively. Mean LCEA and ACEA of the 3 unaffected hips at onset of SCFE, just prior to the PAO and post-PAO were all normal. Clinical outcome measures showed modest improvement in mean HHS preop (54) to postop (59) and in mean UCLA activity score.
***Conclusions*** SCFE-associated acetabular dysplasia seems more anterior than lateral. Our early experience is that clinical improvement after PAO is modest. Further analysis of this difficult problem is needed.

Hip

**EP-031**

**What is the value of perinatal risk factors in predicting radiographic acetabular dysplasia?**

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**Level II**

***Introduction and Objective*** The prognosis of patients with a risk factor for DDH has not been well determined. We wanted to discern which perinatal risk factors are associated with DDH at age ≥2 years.
***Materials and Methods*** In 1053 infants who all had ≥1 of 9 widely-accepted perinatal risk factors for DDH ascertained prospectively, we performed a pelvis radiograph at age 4.4 years (range, 2-7). Two radiologists determined the Acetabular Index (AI) blinded to risk factors. We defined AI >2 standard deviations from reference values as the primary outcome (Tonnis 'severe' dysplasia). The secondary outcome included hips showing AI >20° at age >3 years. We determined the association between risk factors and outcomes using logistic regression. We adjusted for the fact that 37 hips had received treatment in infancy.
***Results*** In 27 participants (2.6%) the hips showed 'severe' dysplasia (primary outcome). Of those, 3 participants had received treatment in early infancy. While girls were more likely to show this outcome (OR=2.6; 95% CI 1.0, 6.5; *P*=0.04), no other risk factor predicted this this outcome. The secondary outcome appeared in 146 participants (13.8%). Of those, 12 had received treatment. We observed the following predictors for this outcome: female sex (OR=1.8; 95% CI 1.2, 2.6; *P*=0.003); first born (OR=0.7; 95% CI 0.5, 0.9; *P*=0.03); breech presentation (OR=1.7; 95% CI 1.1, 2.8; *P*=0.02).
***Conclusions*** While girls had a 3-fold increased risk for 'severe dysplasia' at a mean age of 4 years (24 of 27 had no history of DDH), the other perinatal risk factors were of limited value in predicting this outcome. The study identified 13% of cases without a history of DDH who had an abnormal AI, for which 'breech' and 'female' were significant predictors.

Hip

**EP-032**

**Diffusion MRI provides early prognosis in Legg Perthes Calvé disease**

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**Level III**

***Introduction and Objective*** Early prognosis factors are valuable in Legg Perthes Calvé (LPC) disease. In a preliminary study, we had demonstrated that Apparent Diffusion Coefficient (ADC) ratio of the femoral neck obtained by diffusion MRI was positively correlated to Herring classification: if superior to 1.63, it was associated with a bad prognosis. The aim of the current study was to confirm this result at a longer follow up.
***Materials and Methods*** 27 children (mean age 13 years, range 9.5-16) with unilateral LPC were included in a prospective, consecutive series. 49 MRI scans were performed at either the initial or fragmentation stage. ADC of both the femoral head and neck were measured bilaterally and ADC ratio between affected and unaffected side were calculated then compared to the Stulberg type at latest follow up.
***Results*** Mean follow up was 6.8 years (5.2 to 8.4) from primary MRI. There was a positive correlation between ADC ratio of the femoral neck and Stulberg type ($p<0.01$), included for MRI performed at the initial stage ($p=0.03$). An ADC ratio

above 1.63 was positively correlated with to high Stulberg type (p=0.02).
***Conclusions*** Diffusion presents several advantages including being non radiating and non invasive. It does not need contrast enhancement and it can be performed without anaesthesia or sedation. The origin of the increased ADC remains unknown. Basically, it reflects molecular changes (true diffusion) but it is also influenced by the vascular supply (pseudo diffusion). ADC ratio can provide an early prognosis before Herring classification is applicable, namely, at the fragmentation stage. We confirmed our preliminary results and the threshold value of 1.63.

Knee

**EP-033**

**Is concomitant proximal fibular epiphysiodesis necessary in proximal tibial eight-plate guided growth for limb-length discrepancy?**

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**Level III**

***Introduction and Objective*** Eight-plate guided growth is an option for the treatment of limb-length discrepancies (LLD). The goal of this study was to evaluate whether proximal fibular overgrowth would cause coronal mechanical axis (MA) deviation in LLD patients treated with proximal tibial Eight-plate guided growth without concomitant proximal fibular epiphysiodesis (PFE).
***Materials and Methods*** This is a retrospective study of patients who underwent proximal tibial Eight-plate guided growth with/without distal femur guided growth for LLD with a minimum of one year follow up from Nov. 2013 to July 2017. We reviewed preoperative and final long standing anteroposterior radiographs to assess LLD, tibial and fibular growth, proximal fibular overgrowth, zone of the MA, medial proximal tibial angle (MPTA) and the percentage of MA bisects total width of the knee joint (MA%, from the most medial to lateral side as 0% to 100%). The contralateral limb was used as a control.
***Results*** Fourteen children met the inclusion criteria. None of the patients received concomitant PFE. Mean age was 10.0 years (4 to 13). Pre-operative and final mean LLD were 2.45 cm and 0.40 cm respectively. There was no significant difference between the pre-operative and final MPTA and MA%. Proximal fibular overgrowth was significantly greater in operative limb (6.0mm) than in contralateral limb (1.4mm, $p$ = 0.0168) but was not clinically significant (≤10 mm). Interestingly, without concomitant PFE, ipsilateral fibular growth (27.2mm) was significantly less than contralateral side (32.5mm, $p$ =0.0285).
***Conclusions*** Proximal tibial eight-plate guided growth without concomitant PFE is effective for children with LLD. There was no significant change in coronal MA following the procedure. Proximal fibular overgrowth was not clinically significant but should be monitored during follow up.

Knee

**EP-034**

**Hemiepiphysiodesis using tension-band plate: does initial screw angle influence speed of correction?**

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**Level IV**

***Introduction and Objective*** The purpose was to determine if a relationship exists between initial screw angle and correction speed during hemiepiphysiodesis with tension-band plates.
***Materials and Methods*** Forty patients (54 physes) with genu valgum deformity (20 idiopathic, 20 congenital) underwent tension-band plating between 2010 and 2015. Initial screw angle was measured on intraoperative fluoroscopic images. Radiographs were obtained within 3 months of surgery and every 3 to 6 months thereafter. Change in lateral distal femoral angle, medial proximal tibial angle, and screw angle was obtained from each follow-up radiograph. Initial screw angle was correlated with average correction speed during the entire treatment period.
***Results*** Correlation between initial screw angle and average angular correction speed was negative but not statistically significant. However, after removing five physes with initial screw angle of 0° (parallel screws) and recalculating, the relationship between initial screw angle and average angular correction speed was significant (p = 0.02). Narrow screw angles corrected faster. Angular correction speed during the first follow-up period (mean 4.7 months) was 0.86° per month compared to 0.71° per month during the last follow-up period (mean 5.1 months).
***Conclusions*** Tension-band plates applied with narrow screw angles result in speedier angular corrections, due to a farther virtual center of rotation created by screw-line extension. Plates with parallel screws take additional time to diverge several degrees to create a far center of rotation at which maximum angular correction speed is reached. This extraphyseal fulcrum is dynamic and comes closer to the edge of the growth plate as screws diverge, resulting in decreasing angular correction speed over time.

Knee

**EP-035**

**Evaluation of skeletal maturity using the distal femoral physeal central peak is not significantly affected by radiographic projection**

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**Level III**

***Introduction and Objective*** Recent data shows peak height velocity occurs on average at 90% of final adult height, providing an improved standard to quantify skeletal maturity. Measurement of topographical changes to the developing distal femoral physis on antero-posterior (AP) radiographs allow for calculation of the central peak value (CPV), shown to provide accurate prediction of 90% of final height. The purpose of this study was to assess the clinical tolerance of the CPV method by comparing measurement reliability between AP radiographs of the knee versus standing hips-to-ankle radiographs.
***Materials and Methods*** We searched our institution's clinical database for skeletally immature male (aged, 7-18 years) and female (aged, 7-16 years) patients with both standard AP radiographs of the knee and standing hip-to-ankle radiographs, obtained within 6 months. CPV was measured using our previously published method. Intraclass correlation coefficient (ICC) was calculated to determine the level of agreement between observers. CPVs were analyzed to determine differences between radiographic projection and sex.
***Results*** Seventy-eight subjects were identified. ICC value was 0.873, indicating excellent inter-observer reliability. Mean time between radiographs was 0.30 years for males and 0.27 years for females. CPV values based on radiographic projections were not significantly different in males ($p=0.37$), females ($p=0.22$) or males + females ($p=0.17$). CPV values were significantly greater in males on both AP radiographs ($p<0.001$) and standing hip-to-ankle radiographs ($p<0.001$) when compared to females.
***Conclusions*** CPVs are not significantly different between standard AP radiographs of the knee versus standing hip-to-ankle leg length radiographs, expanding the potential to utilize this method without the need for additional expense or radiation.

Miscellaneous

**EP-036**

**Defining the normal proximal tibio-fibular relationship in children: a simple radiographic measurement**

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**Level II**

***Introduction and Objective*** Disruption of the relationship between the proximal tibia and fibula is recognised in a number of different conditions such as skeletal dysplasias, post-infective sequelae, and as the consequence of lengthening procedures. Radiographic indices for the tibio-fibular relationship at the ankle have been described, but no similar measures have been reported for the proximal ends. The purpose of this study was to determine the normal relationship and variation between the proximal tibial and fibular physes in children.
***Materials and Methods*** Our radiology database was used to identify a sample of 500 normal anteroposterior radiographs of paediatric knees. All radiographs were reviewed by a single observer. The distance from the corner of the lateral tibial plateau to both the proximal tibial (PT) and fibular physes (PF) was measured, and a ratio of the two calculated (PF/PT). The process was repeated with a sample of 100 radiographs by the same observer, and a second independent observer to calculate intra-and inter-observer reliability.
***Results*** The age range of patients in this study was 4-16 years, with mean age 12.7. The mean PF/PT ratio was 1.7 (SD 0.2, range 1.3-2.0). Intra-observer reliability was 100% and inter-observer reliability was 97.8%.
***Conclusions*** The PF/PT ratio is a simple and reliable way of quantifying the relationship between the proximal tibia and fibula in children, using a standard anteroposterior radiograph. The results of this study demonstrate that in the normal paediatric knee, there is a consistent relationship between the position of the proximal tibial and fibular physes, with a small range of variation. This information could help in the further investigation, diagnosis and surgical management of a number of different causes of tibial and fibular deformities in children.

Miscellaneous

**EP-037**

**Cumulative radiation exposure for low dose slot-scanning imaging versus scanogram and hip-to-ankle radiograph**

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**Level III**

***Introduction and Objective*** Low-dose slot-scanning radiography (EOS) is designed to reduce radiation exposure for children. To date, no studies have evaluated the cumulative effect on radiation dosing from switching to a low dose biplanar imaging system for lower extremity patients. We sought to quantify the reduction in cumulative radiation exposure over the entire course of treatment using uniplanar and biplanar slot imaging as compared to scanogram and hip-to-ankle radiographs.
***Materials and Methods*** 31 skeletally immature patients with leg length discrepancy (LLD) were followed until skeletal maturity. All patients underwent treatment with epiphyseodesis. The number of radiographic full-length studies was recorded. A computerized dosing model was used to calculate total effective and organ dose for uniplanar and biplanar studies with copper filtration, scanogram (low dose digital radiography of hip, knee, ankle), and hip-to-ankle (stitched low dose digital radiography) techniques.
***Results*** Mean number of x-rays per patient was 10.2 (range, 3-20). Mean cumulative total effective dose for each kind of imaging techniques was 0.17 mSv (slot uniplanar), 0.42 mSv (slot biplanar), 0.82 mSv (scanogram), and 0.78 mSv (hip-to-ankle film). For reference, annual background radiation in the

U.S. is 3 mSv, a chest x-ray is 0.1 mSv, and a CT abdomen is approximately 5 mSv. Total effective dose for slot scanning uniplanar technique was less than ¼ the dose of the hip-to-ankle and scanogram techniques.
***Conclusions*** Hip-to-ankle/scanogram techniques resulted in a 4.7X higher cumulative radiation exposure compared to slot uniplanar imaging. Over the course of treatment (mean 9 years, 10.2 x-rays), switching from a scanogram to uniplanar slot scanning imaging (EOS) would reduce patient radiation exposure by a total of 0.72 mSv.

Neuromuscular

**EP-038**

**Hip reconstruction including a Dega type pelvic osteotomy in patients with neurologic movement disorder and closed triradiate cartilage – should we do it?**

**Thomas Schlemmer*** [1]; Erich Rutz[1]; Bernhard Speth[1]; Reinald Brunner[1]

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**Level III**

***Introduction and Objective*** Hip reconstruction is an established procedure in pediatric patients with neurologic hip dislocation. It includes a corrective femoral, pelvic modified Dega osteotomy, an open reduction and soft tissue correction when indicated. An open triradiate cartilage provides the advantage of a high plasticity of the bone which prevents an intraarticular fracture and enables postoperative adaptation of shape. In some cases, the dislocation is neglected. The feasibility of the procedure was shown earlier but the long-term risk for osteoarthritis, recurrence of dislocation and poor functional outcome is unknown.
***Materials and Methods*** We retrospectively analyzed 48 hips in 41 patients with a hip reconstruction after closure of the triradiate cartilage. Age at surgery was 15.1 years on average, follow up time 13.4 years.
***Results*** Mean Kellgren Lawrence score at final follow up was 1.94 out of 4 (SD 0.84; range 0 to 4) which was significantly higher ($P < 0.00001$) than preoperatively with a score of 0.86 (SD 0.59; range 0 to 3). In only 5 hips pain was a problem. Reimers migration index was stable over the years with 5.73% (SD 8.50; range 0 to 30) at last follow up which was not significantly higher than short-term postoperatively ($P = 0.849$). We found no difference in range of motion of the hip and change of GMFCS level. There was no influence of spondylodesis, duration of spica casting, GMFCS level, preoperative and short-term postoperative migration percentage on the development of osteoarthritis.
***Conclusions*** Even though radiological findings of osteoarthritis were seen possibly after an intraarticular fracture of the acetabulum during surgery, a hip reconstruction in patients with neurologic movement disorders and closed triradiate cartilage is a valuable option which results in a stable, painless hip for many years.

Neuromuscular

**EP-039**

**How does the shape and the orientation of the acetabulum change in patients with spastic hip disease? Three dimensional CT based study**

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**Level III**

***Introduction and Objective*** Spasticity in patients with Cerebral Palsy (CP) gradually leads to hip dislocation with its rudimental effect on the structure and spatial position of the acetabulum. Being well described in the literature in terms of its shape and two-dimensional orientation, the acetabulum morphology lacks thorough three-dimensional analysis based on the spatial models. Thus, the aim was to assess the acetabulum spatial orientation in Spastic Hip Disease.
***Materials and Methods*** 28 hip joints (22 dislocated and 6 unstable) in 20 patients with CP were analysed in terms of the acetabulum orientation based on the spatial reconstructions of the Computed Tomographies of these patients' pelvises. Unique method of obtaining the acetabulum axis was used. The control group consisted of 34 pelvises' CT investigations (68 acetabula) of individuals without any bone lesions nor deformities. Comparison of the spatial orientation (described by inclination, anteversion and tilt angle) was done between two groups with the use of the statistical analysis (one way ANOVA, Brown-Forsythe test).
***Results*** Comparison of spastic hips with the control group revealed significant decrease in the average acetabulum anteversion (-1,4°± 30,8° on the affected side, while 29,9°± 9,1° in the control group, $p<0,001$) and increase in inclination (85,3°± 22,7° and 71,2°± 6,0°, respectively, $p=0,003$) in the affected hips. There was no significant difference in the tilt angle (20,7°± 114,2° on the affected side, 31,8°± 12,4° in the control group, $p=0,611$).
***Conclusions*** Acetabulum in patients with Spastic Hip Disease is severely retroverted with the increase of its steepness, what questions the use of the classic supraacetabular osteotomies and what may promote other surgical techniques, which are addressed to change the acetabulum orientation (e.g. triple pelvic osteotomy).

Trauma

**EP-040**

**Complex open pelvic fracture in an 8-year old girl treated with infix – a case study**

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**Level V**

***Introduction and Objective*** We describe the case of an 8-year old female patient with an open pelvic fracture after being hit by a bus. The pelvis was stabilized using the INFIX technique. This technique has been described in cases of adult unstable fractures but never in children. The pelvic INFIX and EXFIX are surgical temporary stabilising techniques for the treatment of unstable closed or open pelvic ring injuries. The use of an INFIX technique over that of an EXFIX is mainly related to its subcutaneous position, which is an advantage in cases of severe soft tissue envelope injuries.
***Materials and Methods*** After initial advanced trauma life support management she underwent embolization of the side branches of both internal iliac arteries. She was found to have extensive perineal, left thigh, groin and right buttock degloving injuries and the pubic fragments were exposed in the lacerations. A laparotomy and a colostomy were subsequently performed. After clinical examination and CT the patient's pelvic fracture could best be described as a bilateral unstable lateral compression type 1 fracture as per Young and Burgess classification and type IV Torode/Zieg.
***Results*** It was decided to reduce the pelvic ring and stabilise it by using an INFIX surgical technique after the insertion of one transiliac transsacral cannulated partially threaded screw (7.3/16mm). Fluoroscopy was used to place the supra-acetabular pedicle screws. The starting point AIIS was determined by using an obturator-outlet and an iliac oblique view.
***Conclusions*** These severe rare injuries are best treated using a multidisciplinary approach. External fixators can be used, but in such cases with significant soft tissue injuries around the fixator insertion sites, an INFIX technique is safer and more beneficial for the postoperative rehabilitation stages.

Tumours

**EP-041**

**Long-term results of osteoarticular reconstructions of pediatric periarticular bone sarcomas with free fibula head flap**

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**Level IV**

***Introduction and Objective*** Endoprosthetic reconstruction performed in periarticular bone tumors has limited durability in children. We aimed to investigate the role of fibula head flap for joint reconstruction after osteoarticular tumor resections in children.
***Materials and Methods*** Twenty-five children [average age 12 (6-18) years)] with primary bone sarcomas of the proximal humerus (17), distal radius (4) and proximal femur(4) underwent wide surgical resection and osteoarticular reconstruction with free fibula head flap with proximal articular surface. Fibular flap was combined with recycled autograft (by extracorporal irradiation) in all proximal femoral reconstructions. The average follow-up was 58 (40-110) months.
***Results*** Fibular flap united and hypertrophied in 24 (96%) patients at 12 months; it continued to thicken till the end of 24 months. Fibular flap and recycled bone osteointegration was detected in all proximal femoral reconstructions at 24 months. Slight to moderate remodeling of the fibular head was achieved in most cases. Average final follow-up MSTS scores for lower and upper extremity reconstructions were 82% (76-90%) and 84% (72-92%), respectively. 3 (12%) complications, including delayed union (1), implant failure (1) and wound problem (1) required re-operation. Donor site complications [six (24%); transient nerve palsy (5), wound problem (1)] were managed conservatively. The disease relapsed in 3 (12%) patients in terms of distant metastasis. Defect size and fibular flap length didn't correlate with radiological parameters and MSTS scores ($p>0.05$).
***Conclusions*** Performing autologous arthroplasty using a free fibula head flap may be a promising alternative to an endoprosthesis or alloplastic reconstruction in children with periarticular bone sarcomas, with gradually increasing radiological and functional results and acceptable morbidity.

Tumours

**EP-042**

**Is MRI for the indication of extra-articular excision in children knee osteosarcoma a reliable exam?**

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**Level IV**

***Introduction and Objective*** Tumor resection can be performed by two approaches according to joint contamination in children knee osteosarcomas with epiphysis invasion: the extra articular excision or the trans-articular excision. Knee joint involvement is usually evaluated by a MRI. The aim of the study was to assess the reliability of the MRI for the indication of extra-articular resection in pediatric knee osteosarcomas.
***Materials and Methods*** A monocentric retrospective study was performed between 2013 and 2016 on 9 patients consecutively operated on a knee osteosarcoma with an extra-articular excision approach. The indication was based on the presence of knee joint contamination signs (effusion, collateral ligaments, cruciate ligaments and/or meniscus invasion) on pre- and post-chemotherapy MRI. These results were compared with anatomopathological results of the resection piece. Rate of complications was reported as well as functional results (Musculoskeletal Tumor Society (MSTS) score).
***Results*** Among patients, 3 had an isolated joint effusion, 5 a cruciate ligaments invasion and one the association of both signs on the MRI. Joint invasion was confirmed by the anatomopathologist in one case. The rate of postoperative complications was of 56% (skin necrosis, early and late surgical site infections) and MSTS score was fair (mean 13.6/30).

***Conclusions*** Extra articular resection is safe regarding oncological concerns. However, functional results and rate of complications are much higher than trans-articular excision. Therefore, indication for this approach should not be exclusively based on MRI findings. While joint effusion can be easily assessed by clinical examination, invasion of other articular elements remains more difficult to assess and a mini-arthrotomy could be proposed if there is any doubt on the MRIs.

Basic Science

**EP-043**

**Collagen remodeling in a micro-tissue system: preliminary results**

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**Level III**

***Introduction and Objective*** Treatment for adolescent idiopathic scoliosis is applied only after substantial curve progression has occurred, even though early treatment would be more effective. This is because we cannot distinguish between patients with slow or fast progressing curves. We hypothesize that we can distinguish between these groups by investigating collagen remodeling of the intervertebral disc. Recently, strains of mice have been identified with differences in their connective tissue healing capacity and their disc wedging characteristics, i.e. C57BL/6J and LG/J. In this experiment, we determine whether an in-vitro micro-tissue assay can distinguish the differences in collagen remodeling rates of AF cells between these strains.
***Materials and Methods*** Annulus fibrosus (AF) and skin fibroblasts of 8-week-old C57BL/6J en LG/J mice were expanded in a hydrogel in a tissue remodeling platform, consisting of constraining posts and cultured for 48 hours. Hereafter the tissues were released from one opposing set of posts and cultured for an extra 48 hours. Tissue surface area, waistcoat contraction and collagen orientation were measured.
***Results*** 5 C57BL/6J and LG/J AF tissues were analyzed. 48 hours post-release the tissue surface area and waistcoat contraction was 10.49±0.34 mm and 0.79±0.03 mm for C57BL/6J and 9.43±0.33 mm and 0.68±0.02 mm for LG/J ($p \leq 0{,}001$). No difference in collagen orientation was seen.
***Conclusions*** A difference in AF collagen remodeling was seen in terms of changes in surface area and waistcoat contraction, however no difference in collagen orientation was seen. The next step is to determine whether these differences are reproducible in skin fibroblasts which are more clinically accessible. This would pave the way towards development of a skin biopsy bioassay for the prediction of curve progression in human patients.

Basic Science

**EP-044**

**The biomechanical comparison between tens, K-wires and plates for surgical treatment of the pediatric forearm shaft fractures**

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**Level III**

***Introduction and Objective*** There are two main methods for surgical treatment of the forearm shaft fractures in children: elastic stable intramedullary nailing (ESIN) using TENs or K-wires and plating.
***Materials and Methods*** 3D biomechanical computer models of intact ulna and radius, simple transverse diaphyseal fracture of both bones, and with different types of osteosynthesis – ESIN with TENs and K-wires, locking compression plate (LCP) - have been created on CT scans of the ulna and radius by using SolidWorks software. These methods of surgical stabilization of the forearm shaft fractures were evaluated by SolidWorks with Finite Element Method (FEM) comparative analysis of the von Mises stress-strain relations (SSR) under loads (stretching load (10 N); load in the sagittal plane, directed forward and backward (10 N); load in the front plane, directed from the outside to the inside (10 N); torsion (1 Nm)).
***Results*** The largest changes in SSR were observed in the torsion simulation. K-wires and TENs are provide increase of the stress-strain state (SSS) in the area of the fracture (ulna-71.53-119.9 MPa (intact bone-2.43 MPa); radius-57.29-96.93 MPa (intact bone-2.14 MPa)) by redistribution of the forces in distal and proximal forearm. With the LCP model were observed redistribution of the forces in the area where the plate and screws were in contact to the bone, which unload fracture site (especially on the opposite to plate side), reduces SSS (ulna-2.14 MPa; radius-1.3 MPa) in comparison with the intact bones and osteosynthesis using K-wires and TENs.
***Conclusions*** The optimal parameters of the stress-strain relations for fusion of the forearm shaft fracture have achieved from the model with the TENs and K-wires. Otherwise, the unloading of the fracture zone in the LCP model may be the cause of a malunion.

Congenital, Syndromes, Skeletal Dysplasias

**EP-045**

**Incidence and severity of the foot changes in proximal femoral focal deficiency (PFFD)**

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**Level II**

***Introduction and Objective*** Because the incidence of the foot-changes and their correlation to severity of PFFD is unknown, the aim of this study was to describe them.
***Materials and Methods*** 83 patients with PFFD Pappas classes II-IX were treated between 1996 and 2017. Severe classes (II-V) include 38 patients and mild classes (VII-IX) 45 patients, respectively. Length of fibula, shape of the ankle joint, tarsal coalition and number of foot rays were evaluated using plain radiographs and CT-scans.
***Results*** Short fibula prevailed (69 extremities, 83%) and fibula was absent in 10 extremities (12%). Normal length of fibula was found in 4 extremities (5%) in mild classes VII-IX and fibular aplasia was found in severe classes II, III and V. Ankle joint was mostly valgus (69 extremities, 83%) and prevailed in all classes. Spherical ankle was found in 10 extremities (12%) in severe class II and mild classes VII-IX and was connected with tarsal coalition in 50% of cases. Tarsal coalitions were found in 10 extremities (12%), and were present in all classes except classes IV and VII. Talo-calcaneal coalitions were found in all and additional coalitions were found in 7 patients. The coalitions were connected with fibular aplasia (6 patients) or with fibular hypoplasia (4 patients). Foot rays were reduced in 13% of patients and were found in all classes except class IV and IX. Fibular aplasia does not correlate with the reduction of the foot rays.
***Conclusions*** In contrast to literature reports, changes of the fibula and ankle joint represent constant part of the PFFD, whereas tarsal coalition and reducing of foot rays do not. The severity of the foot changes does not correlate to severity of PFFD, except fibular aplasia. Therefore, treatment of PFFD should always involve the foot with necessity to retain foot position under the tibia.

Congenital, Syndromes, Skeletal Dysplasias

**EP-046**

**Can guided growth be one of the methods to correct valgus knee in congenital femoral deficiency?**

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**Level IV**

***Introduction and Objective*** Congenital femoral deficiency (CFD) representing a spectrum of limb deformity including knee valgus. Guided growth by tension band plating (TBP) is commonly used to correct coronal plane deformities around the knee. The aim of this study was to evaluate the efficacy, rate of correction (ROC) and complications of guided growth by temporal hemiepiphysiodesis with TBP as a potential method to correct valgus knee in patients with CFD.
***Materials and Methods*** A retrospective multicenter study conducted in 5 centers included data on 27 physes (19 distal femur, 8 proximal tibia) in 25 patients (9 females, 16 males) with an average follow-up of 24.1 months after surgery. Preoperative alignment analysis was compared with 3 measurements postoperatively. Normalization of the mechanical lateral distal femoral and medial proximal tibia angles (mLDFA, mMPTA 85-90 degrees respectively) was documented.
***Results*** Average age at surgery was 10.9 years (range 3.1-16.7). 15/19 of the distal femurs (78.9%), 6/8 of the proximal tibia (75%) completed normalization of their deformity. Average pre-op mLDFA, mMPTA were 83 (range 68-84, SD 3.2), 96 degrees (range 92-110, SD 2.9), respectively. After two years of treatment, average mLDFA, mMPTA were 88.3 (range 79-92, SD 3), 90.2 degrees (range 88-96, SD 3.3), respectively. Femur and tibia ROC during first 6 months were 0.62 and 0.78 deg/month respectively, after 6 months 0.44 and 0.37 deg/month respectively. During the second year they were 0.39 and 0.52 deg/month respectively. Complications included one patient with late infection and one with growth plate closure.
***Conclusions*** Guided growth by TBP may be a potential method to temporarily correct valgus knee in patients with CFD. It offers fair results with slower ROC compared to idiopathic angular knee deformity, which declines after 6 months.

Congenital, Syndromes, Skeletal Dysplasias

**EP-047**

**Total hip replacement (THR) in skeletal dysplasia (SKD) patients - early results**

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**Level IV**

***Introduction and Objective*** THR may improve the function and quality of life in (non-SKD) young adults with end stage hip arthritis. The objective is to report the clinical and functional outcome of THR in SKD patients in AIDHC
***Materials and Methods*** The IRB approved a retrospective review of the medical charts and radiographic images. All patients had SKD treated with THR at one institution from 1/1/1990 to 08/31/2017. The indication for THR was

persistent hip pain and loss of function. Statistical analysis was primarily descriptive.
***Results*** 17 arthroplasties were performed in 10 patients, 3 customized. Most common SKD were Morquio Syndrome and Spondyloepiphyseal Dysplasia. All patients had degenerative arthritis Tönnis III. At the last follow up (average of 19.7 months), 2 patients had hip pain after prolonged ambulation. Femoral fracture (split) was seen in 6 hips requiring additional stabilization with cables. 7 hips need acetabular graft. None had component loosening peri-operatively. 1 patient developed Brooker grade 3 heterotopic ossification around the hip and 1 had Brooker grade 2 involvement. None of the patients who had intraoperative neuromonitoring had any post-operative neurologic deficits. The average inclination of the acetabular cups postoperatively was 49.4 degrees and there was no evidence of loosening over the short term follow up. Hip range of motion increased from pre- to last follow up assessment. No infections, dislocation or neurologic injury.
***Conclusions*** With adequate planning and resources, these complex surgical procedures can be carried out with acceptable complication rates. Total hip arthroplasty, though complex, is useful in improving pain and function in the short term in patients with SKD. Longer follow-up within this population is needed to determine revision history and associated issues.

Congenital, Syndromes, Skeletal Dysplasias

**EP-048**

**Retro-patellar technique for telescopic intramedullary nailing**

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**Level IV**

***Introduction and Objective*** Telescopic intramedullary nail has become the main choice of treatment in children with osteogenesis imperfecta or long bone deformities, who have remaining growth potential. Classical tibial nailing technique poses difficulty in relatively small children when the underlying disease causes deformity of the proximal tibia. In this report, it is aimed to introduce the short-term results of retro-patellar tibial telescopic nailing (RTTN) in children.
***Materials and Methods*** The technique involves a 2 cm skin incision proximal to the superior pole of the patella. The nail is inserted to the proximal tibial surface when the knee is positioned about 20 degrees of flexion. After the male part passes the osteotomy or the fracture site, the female part is advanced. Finally, the distal tip of the male part is secured with two K-wires. The patients were allowed to move the extremity without any splint until bony union when weight bearing was begun. Three patients who had undergone RTTN were reviewed after one year of follow-up. Any complication such as implant failure, joint irritation, malunion, nonunion or refracture were recorded.
***Results*** The average age of the patients was 3.5 and the average follow-up period was 13 months. There was not any complaint involving the knee. All three patients showed complete union with no implant failure or refracture. The tibial insertion site was successfully located, and the proximal part of the female part was not protruding anteriorly or superiorly. We did not observe any nail protrusion or loss of correction during the nail insertion.
***Conclusions*** RTTN technique is a safe and presumably more practical alternative to classical tibial telescopic nailing technique in treatment of fractures or deformities in children with osteogenesis imperfecta or other skeletal deformities.

Foot

**EP-049**

**Surgical treatment of recurrent clubfoot after Ponseti correction only requires minimally invasive surgery**

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**Level IV**

***Introduction and Objective*** In contrast to recurrences after posteromedial release (PMR), relapses following treatment of idiopathic talipes equinovarus (ITEV) by the Ponseti method can be treated by repeat manipulation, casting, and soft tissue procedures. We hypothesize that, at follow-up at a minimum age of four years, only minimally invasive surgery is required in the continued management of the ITEV when treated initially with the Ponseti method.
***Materials and Methods*** A retrospective chart review of patients with ITEV treated by the Ponseti method was conducted. Inclusion criteria were patients with ITEV, less than 90 days of age at initial visit, no previous series of casts, and potential of being four years of age at last visit.
***Results*** One hundred and fifty feet were included in our study. Mean age at initial visit and latest follow-up were 19.5 days and 91.3 months, respectively. Fifty eight percent did not undergo any form of surgical procedure, while 33% underwent a tibialis anterior tendon transfer (TATT) in isolation or in combination with a soft tissue procedure. Only three feet (2%) in two patients underwent a PMR.
***Conclusions*** In contrast to those treated for recurrence after PMR, the vast majority (98%) of patients with recurrence after Ponseti-treated ITEV had either no surgery, or minimally invasive surgery involving only soft tissues.

Foot

**EP-050**

**Outcome of talocalcaneal coalition resection assisted with intra-operative navigation**

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**Level IV**

***Introduction and Objective*** Treatment of a symptomatic tarsal coalition is resection. The complications of resection include, incomplete resection or removal of excessive bone resulting in instability. Lack of surgical precision can result in pain, instability, or reossification. Visualization issues during surgery can influence precise resection. The purpose of this study is report on the postoperative outcomes after talocalcaneal (TC) resection using intraoperative navigation (ION).
***Materials and Methods*** An IRB approved retrospective review was performed for pediatric patients who had resection of (TC) coalition assisted with ION from 2008-2018. Frequencies and descriptive statistics are reported.
***Results*** 42 (TC) coalition between 2008-2018. 11 patients (26.1%) underwent resection using ION with fat interposition. Mean age was 11.51±1.46 years. Predominant population was Caucasian-Female (9, 81.8%). Coalition side was: bilateral (3, 27%), left (6, 55%), and right (2, 18%). Symptoms were pain, stiffness, and limitation of activities. Clinical signs were decrease of range of motion and limited subtalar motion. ION aided resection was performed on: right 4 and left 8. Concomitant surgeries for correction of flat foot were performed on 6 feet (50%). Follow up average was 8 months (range 2-18 months). Mild postoperative pain in 2 patients. All patients had Improvement in range of motion, specifically subtalar, and complete resections of the coalitions. 1 reossification was diagnosed by CT (9%). No instability or other complications.
***Conclusions*** The use of ION helps avoid two of the most important complications of coalition resection (incomplete resection and iatrogenic instability). Longer term follow-up is needed to assess outcomes. This technique has a learning curve but provides more precision at the price of increased radiation and cost.

Hip

**EP-051**

**De-threaded screw fixation of slipped capital femoral epiphysis: comparison with standard screw fixation at skeletal maturity. A prospective, case-controlled cohort study comparing outcomes after treatment**

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**Level III**

***Introduction and Objective*** The most common treatment for slipped capital femoral epiphysis worldwide is in situ fixation with a threaded (T) screw. De-threaded (DT) screws aim to facilitate more growth of the proximal femur after fixation which may lead to greater remodelling and improved hip function at skeletal maturity. The objective was to compare these screws for growth, remodelling and long-term outcomes.
***Materials and Methods*** 6 patients (9 hips) treated with DT screws were compared with 16 patients (21 hips) treated with T screws. The groups were matched for skeletal maturity, age, gender and Southwick angle. Patients had complete radiological follow-up until physeal closure. Growth was assessed using 7 variables and the number of screw revision operations. Time to growth completion was recorded and growth velocity calculated. The absence of a CAM deformity on final x-ray signified complete remodelling. Clinical assessment was graded from excellent to poor and patient-reported outcome measures were recorded.
***Results*** The DT group grew more in femoral neck length (p=0.003), articular-lesser trochanter distance (p=0.028), pin-joint ratio (p=0.006) and pin-physis ratio (p=0.001) after adjusting for covariates. Only 1 hip (4.8%) in the T group had a revision operation due to growth, compared to 6 (66.7%) in the DT group. There was no difference between the two groups in time to growth completion, but a significantly higher growth velocity in the DT group. The lower probability of CAM deformity in the DT group was not significant. Functional and clinical results were not significantly different at an average of 11.2 years' follow-up.
***Conclusions*** DT screws allow for significantly more growth than T screws. Despite the extra growth, there was no improvement in remodelling or the clinical and functional outcome scores at long-term follow-up.

Hip

**EP-052**

**Does tranexamic acid reduce blood loss and transfusion rate in children with cerebral palsy undergoing hip reconstruction with two or more osteotomies?**

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**Level III**

***Introduction and Objective*** Despite widespread use of tranexamic acid (TXA) in orthopedic procedures, little is known regarding its use in pediatric patients with cerebral palsy (CP). Patients with CP are at risk of developing hip dislocations requiring reconstruction involving osteotomies of femur and/or pelvis with expected blood loss and need for transfusion. We hypothesized that, in patients with CP undergoing hip reconstruction, use of TXA decreases blood loss and need for allogenic blood transfusion.
***Materials and Methods*** Retrospective chart review of patients with CP who underwent hip reconstruction with 2 or more osteotomies was performed. Age, procedure, preoperative and postoperative hemoglobin/hematocrit, estimated blood loss (EBL), transfusion need and length of stay were recorded. Patients were divided into TXA and no TXA groups.
***Results*** Subjects were 32 patients, mean age 8.7 years. Twenty received intraoperative TXA and 12 did not. Age, EBL, mean preoperative and postoperative hemoglobin or hematocrit,

and length of stay were similar for 2 groups ($p$>.05). Preoperative to postoperative hematocrit drop was significantly less in TXA than no TXA group (11 vs 15%; p=0.039). Risk for intraoperative transfusion (25 vs 10%), postoperative transfusion (25 vs 5%), and any transfusion (41.7 vs 15%) appeared to be greater in no TXA group, but not statistically significantly different.
***Conclusions*** Blood loss following hip reconstruction in patients with CP can have a negative impact on recovery and increase need for allogenic blood transfusion. Also, blood transfusion may pose increased risk for lung, hematogenous or infectious complications. This pilot study shows in patients with CP undergoing hip reconstruction with 2 or more osteotomies, use of TXA may limit hematocrit drop and possibly decrease need for allogenic blood transfusion.

Hip

**EP-053**

**Validation and reliability testing of the Western Ontario and McMaster Osteoarthritis Scale Hip Score in children and adolescents with Legg-Calvé-Perthes disease**

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**Level II**

***Introduction and Objective*** LCPD is a pediatric hip disorder affecting the femoral head. The Western Ontario and McMaster Osteoarthritis Scale (WOMAC) is a questionnaire for hip-specific function, validated in adults with osteoarthritis. WOMAC has been extensively used for pediatric patients with hip conditions, despite not being validated in this population. The purpose of this study was to determine reliability and validity of the WOMAC in a pediatric population with healed LCPD.
***Materials and Methods*** Patients (5-19yrs) with healed LCPD were recruited. All participants completed the WOMAC and Activities Scale for Kids – performance (ASK-p) questionnaires in clinic and were asked to complete a 2nd WOMAC 2 weeks later. A control group of 24 patients with isolated upper extremity fractures were also recruited. Stulberg Classifications were assigned by 2 independent orthopaedic surgeons and agreement was assessed.
***Results*** In total, 41 LCPD patients completed the WOMAC twice. Test-retest reliability showed high agreement (intraclass correlation 0.87). Validity testing showed no differences across Stulberg Classifications (p=0.96), but scores were skewed toward 0. Control group patients had a lower mean score than LCPD patients (1 vs. 5.98, mean difference -4.98, 95%CI [-7.87, -2.09]). There was a moderate negative relationship between WOMAC and ASK-p scores (Pearson correlation -0.37, -0.53 for 1st and 2nd WOMAC respectively). The 2 surgeons exhibited substantial agreement in Stulberg Classification (71%, Kappa value 0.6, 95%CI [0.44, 0.76]).
***Conclusions*** Test-retest scores suggest WOMAC is a reliable questionnaire for the pediatric population. However, there was no score difference between Stulberg stages. The highly skewed scores suggest a floor effect, limiting its effectiveness in the pediatric population.

Hip

**EP-054**

**Hip dysplasia – reduction of luxated head with a distraction nail prior arthroplasty**

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**Level IV**

***Introduction and Objective*** In cases of proximal migration of the femoral head due to dysplasia of the acetabulum total hip arthroplasty (THA) is a challenge and combined with shortening of the leg, a high risk of nerve palsy or a risk of infection using an external fixator to distalize the femur.
***Materials and Methods*** Fully implantable distraction devices have been used frequently for leg lengthening and are offering a new perspective with a new developed pelvic support plate to perform soft tissue distraction of the thigh. The energy necessary for the distraction can be delivered wireless through the skin by an external power and control unit. 15 patients (7m, 8f) with a mean age of 33 years (15-73) were treated using a fully implantable nail before arthroplasty. The mean distraction amount was 53mm (32-60). In an initial surgery the femoral head was resected and the cup of THA was implanted in anatomic position with or without enhancement of the acetabulum. After surgery distraction was started with 2mm/day. In a second surgery the distraction nail was removed and the stem was inserted to complete the THA.
***Results*** In all patients the soft tissue distraction of the thigh was finished as planned preoperatively, so that THA could be performed in anatomic position. No infection occurred. The first 5 patient had a high pain level because the connection to the pelvis was rigid and not flexible enough. After that a new patented support device was used allowing more mobility leading to a significant better range of motion and a lower pain level.
***Conclusions*** A fully implantable motorized distraction nail seems to be a favourable option to reduct a high hip dislocation by continuous soft tissue distraction before THA avoiding acute intraoperative stretching and to reach equal leg length.

Infection

**EP-055**

**Subscapular abscess in the adolescent – a rare case**

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**Level IV**

***Introduction and Objective*** Subscapular abscess in the pediatric age is a rare condition. Local trauma, immunosuppression

and history of recent viral infection are described as major risk factors. Present a rare case of subcapsular abscess in the adolescent surgically treated with good outcome.
***Materials and Methods*** A 13-year-old female, healthy, referred to the hospital emergency with an infectious mononucleosis. Was hospitalized for surveillance and symptomatic treatment. On the 7th day of hospitalization she developed a left omalgia associated with local flushing, fever and ROM limitation. She developed leukocytosis with increased levels of VS and CRP and started amoxicillin. Due the maintenance of painful complaints and MRI showing the presence of abscess at the subscapularis muscle, changed intravenous antibiotic therapy (clindamycin) and underwent surgical drainage.
***Results*** After surgical drainage, there was improvement of clinical and analytical status, with gradual resolution of the associated shoulder symptomatology.
***Conclusions*** Despite the rarity of subscapular abscess, in patients with omalgia and persistent fever their presence should be suspected. S. aureus is the most common agent, however, when antibiotic is initiated prior to collection, the agent is not identified in most situations. Antibiotic therapy with beta-lactam or clindamycin is the treatment of choice for empirical therapy. There are currently no guidelines for the duration of antibiotic therapy, however previous studies have described the need for its use for at least 2 weeks. The combination of surgical treatment with antibiotic therapy, in most situations, allows the correct treatment of the pathology, avoiding the sequelae due to a systemic infection.

Infection

**EP-056**

**Diagnostic yield of cultures in pediatric musculoskeletal infections**

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**Level IV**

***Introduction and Objective*** Morbidity from pediatric musculoskeletal infections remains a challenge because of increasing incidence and pathogen virulence. The aim of this study was to evaluate the results of microbiological cultures and describe the clinical characteristics of pediatric patients with musculoskeletal infections.
***Materials and Methods*** Medical records from children less than 18 years with diagnoses of deep abscess, pyogenic arthritis, acute osteomyelitis, and chronic osteomyelitis were reviewed. We collected age, diagnosis, coinfection rate, pathogen isolation rate from cultures, and pathogen type if it was isolated.
***Results*** Ninety-eight patients with a mean age of 66 months (range 3-172) were identified. Thirty-nine (39.8%) had a deep abscess, 30 (30.6%) had pyogenic arthritis, 23 (23.5%) had acute osteomyelitis, and 6 (6.1%) had chronic osteomyelitis. Fourteen patients (14.3%) had more than one source of infection (deep abscess N=3; pyogenic arthritis N=11). Sensitivity for all diagnoses was 57% (deep abscess 74%, pyogenic arthritis 40%, acute osteomyelitis 39%, chronic osteomyelitis 100%). Staphylococcus aureus was the most frequent pathogen (85.7%). Eight patients (8.2%) had more than one pathogen isolated.
***Conclusions*** Microbiological and clinical patterns of pediatric patients with musculoskeletal infections demonstrated a high percentage of concomitant infections, especially in association with pyogenic arthritis. High false negative culture rates were found in pyogenic arthritis and acute osteomyelitis. The routine use of highly sensitive methods, such as whole-body magnetic resonance imaging to detect coinfections, and whole-genome sequencing to increase pathogen detection yield, are potentially practice-improving additions in the diagnosis of pediatric musculoskeletal infections.

Knee

**EP-057**

**Hemiepiphysiodesis for coronal angular knee deformities: tension-band plate versus percutaneous transphyseal screw**

**Galina Shapiro*** [1]; Tohar Adato[1]; Paz Shai[2]; Tareq Shrabaty[2]; Ron Lamdan[2, 3]; Naum Simanovsky[2]; Michael Zaidman[2]; Vladimir Goldman[2]

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**Level III**

***Introduction and Objective*** Pediatric angular knee deformities are very common musculoskeletal anatomic variations. While most cases do not require surgical correction, some patients with adequate growth potential may benefit from hemiepiphysiodesis. Hemiepiphysiodesis techniques include tension-band plates (TBP) and percutaneous transphyseal screws (PETS) yet very little information comparing these techniques is currently available. We hypothesized that hemiepiphysiodesis using PETS would be as effective as TBP for guided correction of angular knee deformity.
***Materials and Methods*** A retrospective cohort of thirty-five patients (55 physes) treated with either TBP (14 patients 23 physes) or PETS (21 patients 32 physes) for angular knee deformities in one medical institution between 2007 and 2016 was established. The cohort included both genu varum and genu valgum of both primary and secondary etiologies. We compared the treatment groups for differences in both clinical and radiological outcomes of correction and complications.
***Results*** We found that the use of PETS, compared to TBP, was associated with a faster implantation surgery and a shorter interval between implantation and removal, i.e. faster correction. Furthermore, PETS compared to TBP were associated with faster correction rates of the mechanical axis deviation, lateral distal femoral angle and medial proximal tibial angle.

No significant differences in complication rates were found between the two treatments.

***Conclusions*** Percutaneous transphyseal screws provided a faster correction of pediatric angular knee deformities compared to tension-band plates at similar complication rates.

Miscellaneous

**EP-058**

**Accuracy of emergency department and urgent care center pediatric orthopaedic diagnoses**

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**Level II**

***Introduction and Objective*** Emergency departments (ED) and urgent care centers (UCC) are often the first line in diagnosing and managing acute pediatric orthopaedic injuries. The purpose of this study was to assess the accuracy of the diagnoses received from emergency departments and urgent care center visits.
***Materials and Methods*** All pediatric patients who presented for an initial evaluation after being seen in a UCC or outside ED were prospectively recruited. A blinded comparison was made between the official discharge diagnosis from ED/UCC and the diagnosis made at evaluation by the pediatric orthopaedic surgeon. Simple statistics were performed.
***Results*** Two hundred seven patients were enrolled in this study of which 160 patients were treated for upper extremity and 47 patients for lower extremity injuries. The overall correct diagnosis rate from ED and UCC for all injuries was 65% (135/207). For the upper extremity, EDs diagnosed acute pediatric upper extremity injuries correctly in 71% (71/100) of patients in comparison to 57% (37/60) in UCCs. 38% (21/55) of the incorrect diagnoses occurred in multiple bone injuries when a component of the injury was missed (i.e. missed radial neck fracture with concomitant wrist injury, radius or ulna of both bone fractures, Monteggia variant). EDs diagnosed acute pediatric lower extremity injuries correctly in 57% (16/28) of patients in comparison to 74% (14/19) in UCCs. 29% (5/17) of the incorrect diagnoses occurred in multiple bone injuries when a component of the injury was missed (i.e. tibial or fibular component of bimalleolar fractures).
***Conclusions*** ED and UCC diagnoses of acute pediatric orthopaedic injuries are only accurate 65% of the time. Providers are slightly better at diagnosing upper extremity than lower extremity injuries.

Neuromuscular

**EP-059**

**A thirteen-year longitudinal outcome study: is adolescent mobility function preserved in adults with cerebral palsy?**

Faithe Kalisperis[1]; Chris Church[1]; Nancy Lennon[1]; **M. Wade Shrader*** [1]; Kristen Nicholson[1]; Jose de Jesus Salazar-Torres[1]; John Henley[1]; Daveda Taylor[1]; Tim Niiler[1]; Julieanne Sees[1]; Freeman Miller[1]

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**Level II**

***Introduction and Objective*** We used instrumented gait analysis and patient report to examine changes in gait, mobility, and participation of adults with cerebral palsy (CP) from adolescence to adulthood.
***Materials and Methods*** We recruited adults with CP between 25-45 years of age, who had a previous gait analysis as adolescents. Spatial temporal, Gait Deviation Index (GDI), kinematic parameters, and gross motor function from the two visits were evaluated using Motion Analysis System and Qualysis. The Patient-Reported Outcomes Measurement Information System (PROMIS) evaluated current level of physical function, depression, social participation, and pain impact.
***Results*** To date, 60 adults with CP returned for gait evaluation. The mean time between visits averaged 13±5 years. Average adolescent age was 16±3 years and 29±4 years for the adult. GMFCS levels were I 22%, II 52%, III 22%, and IV 5%. GDI, stride length, gait velocity and GMFM-D demonstrated no significant changes from adolescent to adulthood. PROMIS data revealed limited physical function scores. Depression, participation and pain domain scores were no different from a non-disabled sample.
***Conclusions*** Gait and gross motor function were maintained from adolescence to adulthood in this sample of adults with CP. The relative homogeneous orthopedic care that this group received from a single specialty center may explain these outcomes, which differ from recent reports of declining mobility in adults with CP. While physical function was limited for the adults with CP, depression, participation and pain scores were similar to the scores of a non-disabled sample.

Trauma

**EP-060**

**Tibial tuberosity ossification predicts reoperation for growth disturbance in distal femoral physeal fractures**

**Jim Kennedy*** [1]; Dan Westacott[1]; Mark Camp[1]; Andrew Howard[1]

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**Level III**

***Introduction and Objective*** Distal femoral physeal fractures can cause of growth distrurbance which frequently requires further surgical intervention. The aim of this study was to determine if tibial tuberosity ossification (TTO) at the time of injury can predict further surgery in patients with a physeal fracture of the distal femur.
***Materials and Methods*** We retrospectively investigated all patients who had operative treatment for a distal femoral

physeal fracture at a pediatric level one trauma center over a 17 year period. Logistic regression analysis was performed investigating associations between the need for further surgery to treat growth disturbance and TTO, age, Salter Harris (SH) grade, mode of fixation or mechanism of injury.
***Results*** 74 patients met the inclusion criteria. There were 57 boys (77%) and 17 girls (23%). The average age at time of injury was 13.1 years (range 2.0-17.1 years). Following fixation, 30 patients (41%) underwent further surgery to treat growth disturbance. Absence of tibial tuberosity fusion to the metaphysis was significantly associated with need for further surgery ($p$= <0.001). Odds of requiring secondary surgery after tibial tuberosity fusion to metaphysis posteriorly (compared with not fused) were 0.12, 95% CI (0.04, 0.34). The effect of TTO on reoperation rates did not vary when adjusted for gender, mechanism, fixation and SH grade. When accounting for age, the odds of further operation if the tibial tuberosity is fused to the metaphysis posteriorly (compared with not fused) were 0.28, 95% CI (0.08, 0.94).
***Conclusions*** TTO stage at time of injury is a predictor of further surgery to treat growth disturbance in pediatric distal femoral fractures. Children with distal femoral physeal fractures whose tibial tuberosity was not fused to the metaphysis were 8.3 times more likely to require further surgery.

Trauma

**EP-061**

**Pediatric clavicle fractures - is follow-up necessary?**

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**Level III**

***Introduction and Objective*** Clavicle fractures make up 5-15% of all fractures in children. In cases of simple, isolated fractures, complications are rare due to children's significant bone healing capabilities. The purpose of this study is to evaluate whether follow-up appointments are necessary for isolated pediatric clavicle fractures.
***Materials and Methods*** A retrospective data collection study was conducted for patients between the age of 0 – 18 years with an isolated clavicle fracture. Patients, who required surgical intervention, had open fractures or brachial plexus injuries as well as patients that were lost to follow up were excluded. Statistical analysis was performed using Excel for basic descriptive statistics and RStudio to perform scatter plots, spearman correlation, simple linear regression and T-Test between populations.
***Results*** 136 patients were included in this study. Mean age was 7.98 years ± 5.34 (73.5% M, 26.5% F). Mean number of days from fracture diagnosis to final appointment was 40 days ± 22.16 with an average number of 3 follow up visits (± 0.90). Data was found to be bimodal with the cutoff point being 8 years of age. The average number of days from fracture diagnosis to final appointment was found to be lower for younger patients than for older ones ($t$ (339.9) = 3.064, $p$ < .01).
***Conclusions*** While there is not a strong linear relationship between the number of appointments/Days and age, a positive correlation between the variables is noted. This implies there is a positive trend upwards (i.e. the older the patient, the greater the number of appointments/days). Below age 8, isolated clavicle fractures are likely to heal uneventfully, and it can therefore be at the discretion of the treating physician if further follow-up after the initial visit is warranted.

Trauma

**EP-062**

**Our recent experience in management of capitellum and capitellum-trochlea shear injuries in skeletally immature patients**

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**Level IV**

***Introduction and Objective*** Common opinion is that capitellum and capitellum-trochlea shear injury almost exclusively observed in adults.
***Materials and Methods*** During last 2 years we treated 10 skeletally immature patients with this type of injury, with age range from 12 to 15 years.
All children sustained low energy trauma. Isolated fractures of capitellum encountered in five and capitellum-trochlea shear injures in three children. All of capitellum-trochlea shear injures were comminuted. The patients were treated surgically. The features of these injuries, pitfalls of treatment and complications were summarized.
***Results*** Associate injures included radial head, medial and lateral epicondyles fractures, elbow dislocation. No neurovascular damage was observed on initial presentation. The complications we faced with were: early surgical site infection -1case, reserved after oral short course of antibiotics, temporary posterior interosseous nerve palsy, reserved in one week -1, avascular necrosis of capitellum -1 and elbow stiffness seen in 2 cases. These types of injury prone to be underestimated on initial evaluation, but since correct diagnosis is made, the patients can be successfully surgically treated. Isolated fractures of capitellum can be addressed through lateral approach and capitellum-trochlear comminuted fracture is best managed through posterior approach with olecranon osteotomy. The most appropriate fixation was achieved by headless compressive screws or absorbable nails. Adequate visualization can be obtained with minimal soft tissue stripping and preservation of collateral ligaments. Stable fixation permits early range of motions exercise and long standing stiffness prevention.
***Conclusions*** The pediatric orthopedic surgeon has to be familiar with this type of injuries as it seems to be much more common than previously considered.

Trauma

**EP-063**

**Treatment of acute Monteggia fracture dislocations in children**

**Michal Frankl*** [1]; Dan Epstein[1]; Moshe Dahan[1]; Leonel Copeliovitch[1]; Reuven Shitrit[1]

[1]Asaf HaRofe, Zriffin, Israel

**Level IV**

***Introduction and Objective*** Monteggia fracture dislocations in children differ from adults, in that the incomplete fracture of the ulna, which is unique to the immature bone, allows for maintenance of length and of stability. This allows for conservative treatment, in a subset of pediatric patients, but also directs other treatment considerations. Addressing the ulna pattern of fracture, and not the descriptive Bado classification commonly used, is the key in treatment of these fractures.
***Purpose:*** To evaluate the outcomes of our current treatment protocol for pediatric Monteggia fracture dislocations
***Materials and Methods*** A retrospective study. All pediatric patients, who were diagnosed with Monteggia fracture dislocations between January 1st 2008 and June 30th 2017 were included in the study. We reviewed data such as age at presentation, type of fracture, method of treatment, complications, radiologic and clinical outcome at last follow up.
***Results*** A total of 50 Monteggia fracture dislocations were diagnosed within this time period. Fourteen patients were treated with closed reduction and cast, 10 patients were treated with titanium elastic nailing, and 26 patients were treated with open reduction and absolute stability. Good radiographic and clinical results were achieved in 47 patients. Poor results were seen in patients not treated according to Ulnar pattern of the fracture. We had 1 pin tract infection, 1 AIN palsy and 2 radial nerve palsy.
***Conclusions*** Treating according to ulna fracture pattern achieves good clinical & radiological results. Smaller operations, with less morbidity, such as TEN allow very good results for Letts type 2 injuries. Over treatment does not cause failures, but under treatment may cause as high as 20% failure rate.

Trauma

**EP-064**

**A systematic review of the adverse outcomes following conservative versus surgical management of open fractures in the paediatric population**

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**Level II**

***Introduction and Objective*** Effective management of open fractures is important to reduce risk of infection and minimise disruption to bone healing. Open fractures in adults have been extensively studied and early combined ortho-plastics treatment strategies have been advocated. However, in the paediatric population there are still wide discrepancies in the management consensus.
***Materials and Methods*** We performed a systematic review of conservative *versus* surgical management techniques looking at outcomes of open fractures in children. Our primary outcome was infection. Secondary outcomes included incidences of mal/non union and need for further procedures. A comprehensive search strategy included Medline, Embase and CINAHL via NICE Evidence from inception to December 2017. All studies were quality assessed with the ROBINS-I tool.
***Results*** 20 studies (1277 patients) were analysed. Fracture site was specified in 1274:760 lower & 514 upper limbs). Mean patient age was 9.6 yrs (range 7.2-11.5) and mean follow-up 21.4m (range 1.2-68.4m). All patients received antibiotics on admission, 893 (70%) proceeded to formal debridement. 542 fractures (43%) were managed with only traction/casting and 493 fractures (39%) underwent surgical fixation. Concurrent plastics closure was used in 172 patients. Conservative vs surgical management yielded rates of osteomyelitis, 0% vs. 2.4%; wound infection, 0.5% vs. 4.6%; delayed union 3.2% vs. 9.1%; non/malunion 1.7% vs 4 % and return to theatre 3.5% vs. 28.1%.
***Conclusions*** This study is the first to evaluate pooled outcomes for paediatric open fractures. It aims to inform current clinical practice and future research. Findings are limited due to methodological flaws in the design of included studies. However, low infection and malunion rates in both arms imply appropriate decision making by the surgical teams.

Trauma

**EP-065**

**Results of conservative treatment of diaphyseal fractures of the tibia in adolescents**

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**Level IV**

***Introduction and Objective*** Surgical treatment for fractures in pediatric population has increased. Older age has been considered a relative indication for surgical treatment of diaphyseal tibial fractures. We aimed to study the results of a diaphyseal tibial fracture in teenagers treated conservatively.
***Materials and Methods*** We retrospectively reviewed 33 consecutive adolescents that suffer a diaphyseal fracture of the tibia and were treated conservatively. Demographic data, fracture characteristics, time of immobilization and complications were recorded. Our goal of reduction was to obtain <5 degrees of coronal angulation, <10 degrees of sagital angulation, and <1 cm of shortening.
***Results*** Initial radiographic characteristics: shortening 5±3 mm, coronal angulation 2.3±1 degrees, sagital angulation 3.3±2,7 degrees, coronal translation displacement 9% and

sagital translation displacement 13%. There was a tendency to observe more coronal angulation in the proximal third (p=0.07) and more coronal translation in the spiral-type fracture (p=0.06). Closed reduction under general anesthesia was performed in 37%. An optimal reduction was obtained in all patients. Median time of immobilization was 64 days (SD 32). Radiographic characteristics at the time of fracture healing: shortening was 5±5mm, coronal angulation 2.7±2 degrees and sagital angulation 3±3.2 degrees. Secondary displacement occurred in five patients (15%), being more frequent when closed reduction was initially performed (p=0.054) or when initial sagittal angulation was higher (p=0.029). Conversion to surgical treatment occurred in 3 patients (9%).

***Conclusions*** Diaphyseal fractures of the tibia in adolescents are successfully treated conservatively with excellent final alignment. The rate of secondary displacement is 15% and the rate of conversion to surgical treatment is 9%.

Upper Extremity

**EP-066**

**The scapholunate interval in the pediatric population decreases in size as age increases**

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**Level II**

***Introduction and Objective*** Scapholunate instability secondary to scapholunate ligament injury can occur as a result of a fall onto an outstretched hand. These injuries are rare in children but nonetheless can occur, especially in the adolescent population. Widening of the scapholunate interval greater than 2mm is diagnostic of an injury in the adult population. However, the absolute 2mm number cannot be used for the skeletally immature population due to the ossification of the carpal bones. The purpose of this study was to determine age-appropriate normative values for the scapholunate (SL) interval in the skeletally immature population.

***Materials and Methods*** Imaging databases were queried for normal pediatric wrist radiographs. Patient records were cross-referenced to exclude patients with prior wrist injuries or congenital anomalies. The SL interval was measured as the distance between the scaphoid and lunate at the midjoint space. All measurements were reviewed by the senior author to ensure positioning for the radiographs was appropriate regarding assessment of the SL interval. Basic statistical analysis was performed to determine average SL intervals by age.

***Results*** The SL interval was measured in 529 radiographs of children (276 males, 253 females), aged 4-17 years. A negative linear correlation between age and distance at the midjoint space was observed. Ossifying carpal bones were visible on radiographs in patients as young as four years old. Average values for the SL interval ranged from 9.07mm to 1.57mm.

***Conclusions*** The distance between the scaphoid and lunate decreases with increasing age as the carpal bones ossify. The normative values defined in this study can be utilized to determine if a widening of the scapholunate interval is present in the pediatric population, leading to a diagnosis of a SL ligament injury.

Upper Extremity

**EP-067**

**Operative fixation of medial epicondyle fractures: no difference in complication rates based on mode of fixation with high rate of return to sports**

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**Level II**

***Introduction and Objective*** The purpose of this study is to define the rate of implant failure and risk factors for failure in patients treated operatively for displaced medial epicondyle fractures.

***Materials and Methods*** Patients $\leq$ 18 years of age with medial epicondyle humerus fractures that were treated with screw or k-wire fixation between 2005-2015 were eligible. Inclusion criteria included follow-up until radiographic union and no known medical conditions that could impair healing.

***Results*** 34 patients with 35 fractures were identified with an average age of 12 years old. 11.4% (*n*= 4/35) of fractures were treated using K-wires, 25.7% (*n*= 9/35) were treated using a screw and washer construction, and 62.9% (*n*= 22/35) were treated using screw alone. There were 17 reported complications (49%) including implant prominence requiring reoperation (6), implant failure (1), and fracture displacement (1). Other complications included non-union/delayed union (4), new ulnar nerve palsy (2), and decreased range of motion (3). Rates of complications were not different between the types of fixation (*p*= 1.0). Those who developed complications were younger than those who did not (*p*= 0.05). 91.4% of patients returned to full activity including weight bearing and throwing sports.

***Conclusions*** Although 25% of patients experienced implant complication and overall complication rate approached 50%, nearly all reported return to full activity. It may be advisable to immobilize younger children longer in the postoperative period due to their higher rate of complication.

Upper Extremity

**EP-068**

**Congenital forearm pseudarthrosis: a systematic review of literature**

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**Level IV**

***Introduction and Objective*** Congenital forearm pseudarthrosis is a rare entity. For treatment, several surgical techniques are described in literature. The most optimal treatment strategy however remains unclear. This review aims to describe indications for surgery and to determine the optimal non-operative and surgical treatment in order to develop an algorithm for clinical decision making.
***Materials and Methods*** The Embase, MEDLINE, Cochrane Central, Web of Science and Google Scholar databases were searched for published studies reporting on congenital forearm pseudarthrosis. Results were not restricted by date or study type, only English literature was allowed. Studies were assessed for quality using the critical appraisal checklist for case reports from the Joanna Briggs Institute. Outcome of this checklist was transformed into a quantitative score, ranging from 0-10. Patient characteristics, underlying disease, type of surgery, union rate and functional outcome were extracted from included studies. The PROSPERO registration number for this study was CRD42018099602.
***Results*** Of 829 studies identified, 47 were included in this review (17 case series and 30 case reports, total of 84 cases). Quality of reporting outcomes was 5.87 ± 1.76. A one-bone-forearm (OBF) procedure showed highest union rates (92%), but was associated with loss of forearm rotation. Free vascularized fibula grafting (FVFG) showed high union rates (87%) and was related to good functional outcome of elbow flexion and forearm rotations. Other surgical procedures showed disappointing results.
***Conclusions*** Congenital forearm pseudarthrosis is best treated surgically with a FVFG, a OBF procedure should be used as a salvage procedure. Data extracted from the case reports was used to generate a treatment algorithm suitable for clinical paediatric practice.

Upper Extremity

**EP-069**

**Treatment of lateral humeral condyle non-unions in children: an observational study and a review of the literature**

**Giovanni Gallone*** [1]; Giovanni Luigi Di Gennaro[1]; Giovanni Trisolino[1]; Piergiuseppe Tanzi[1]; Diego Antonioli[1]; Stefano Stallone[1]; Stefano Stilli[2]; Eleonora Olivotto[1]

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**Level IV**

***Introduction and Objective*** The aseptic non-union of the lateral humeral condyle (LHC) is a common complication after distal humerus fractures, causing pain, instability, functional impairment and ulnar neuropathy. Surgical treatment is recommended, but burdened by complications (stiffness, limited range of motion and avascular necrosis). The aim of the study is to report the results of a cohort of children managed at our Hospital for LHC non-union.
***Materials and Methods*** During a period of 20 years, 20 patients (mean age 7 years, range 3-14) with LHC non-union were treated at our Hospital. LHC non-union were classified as delayed presentation with loss of reduction (group A), non-union with moderate angulation (group B); non-union with marked angulation (group C). The Flynn's criteria were also applied to rating the non-union. In group A, 2 children underwent conservative treatment and 6 children underwent ORIF. In group B, 5 children received ORIF. In group C, 2 children underwent ORIF (1 with bone allograft) and 5 children received varus osteotomy and ulnar nerve transposition.
***Results*** The average follow-up was 33 (12-120) months. Bone healing was achieved in 19 cases (95%), 3 cases developed mild avascular necrosis that resolved without any surgical treatment, 1 case developed a recurrent valgus deformity. At the latest follow up, the Mayo Elbow Performance Score averaged 98 (50-100), the Dhillon score averaged 8.1 (4-9) and the mean ROM was 130° (100°-140°).
***Conclusions*** LHC can be successfully treated by surgery in the majority of cases, but strict criteria must be applied in order to decide the best choice of treatment.

Upper Extremity

**EP-070**

**Does an associated elbow dislocation lead to worse outcomes in medial epicondyle fractures?**

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**Level II**

***Introduction and Objective*** 50% of all medial epicondyle fractures are associated with an elbow dislocation. The purpose of this study was to assess differences in outcomes and complications between patients with isolated medial epicondyle fractures and those with a concurrent elbow dislocation.
***Materials and Methods*** A retrospective review was performed over a seven-year period. Patients were identified using CPT and ICD-9/10 codes for medial epicondyle fracture and elbow dislocation. Data including demographics, mechanisms of injury, coinciding injuries, treatment modality (immobilization alone vs operative intervention), post-operative range of motion, and complications were obtained. Student's t-tests were used to analyze differences between the samples.
***Results*** Forty-eight patients (22 female, 26 male) with an average age of 10.49 years (range: 4-17) were identified with medial epicondyle fractures, of which 17 had a concurrent elbow dislocation. The fractures with concurrent elbow dislocations more frequently had additional coinciding inju-

ries (8/17 vs 3/31; p=<0.01) including ulnar nerve injuries (2/17 vs 1/31), anterior interosseous nerve injuries (2/17 vs 0/31), UCL tears (2/17 vs 0/31), and other fractures (2/17 vs 2/31). The group with concurrent elbow dislocations was more frequently treated operatively (12/17 vs 8/31; p<0.01). However, final range of motion, as compared to the contralateral side, was not statistically different between the groups (p=0.25). There was no difference in complication rate between the groups (3/17 vs 8/31; p=0.57), percentage of therapy referrals (6/17 vs 7/31; p=0.35), or length of follow up (p=0.77).
***Conclusions*** The outcomes and complications of pediatric and adolescent medial epicondyle fractures with a concurrent elbow dislocation are not different than those of isolated medial epicondyle fractures.

Congenital, Syndromes, Skeletal Dysplasias

**EP-071**

**Limb lengthening and deformity correction with externally controlled motorized intramedullary nails. Evaluation of 50 consecutive lengthenings**

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**Level II**

***Introduction and Objective*** Limb lengthening with an intramedullary motorized nail is a relatively new method. The purpose of this study was to see if lengthening nails are reliable constructs for limb lengthening and deformity correction in the femur and the tibia.
***Materials and Methods*** We performed 75 lengthenings in 72 patients by means of motorized lengthening nails from Nov 2011 until Sept 2018. With a follow-up of at least 12 months after consolidation 50 lengthenings in 47 patients are included in this study. The patients' mean age at operation was 23 (11-61) years. 30 lengthenings were done due to congenital and 20 because of posttraumatic deformity (21 antegrade femora, 23 retrograde femora, 6 tibiae). Initial deformities included shortening in all patients with a mean value of 41 (25-80) mm. In 15 patients, simultaneous axial correction was done when using the retrograde nailing technique.
***Results*** The planned amount of lengthening was achieved in all but 2 patients. 5 patients who underwent simultaneous axial correction showed residual minor deformity. Unintentionally induced minor deformities were found both in the frontal and sagittal planes. All but 1 patient consolidated without further interventions. The consolidation index was in average 1.2 (0.6-2.5) months/cm in the femur and 2.5 (1.6-4.0) in the tibia. There were 8 complications, all of which were correctable by surgery, with no permanent sequela.
***Conclusions*** Controlled acute axial correction of angular deformities and lengthening can be achieved with motorized lengthening nails. However, a thorough preoperative planning and intraoperative control of alignment are required in order to avoid residual and unintentionally induced deformity. In femoral lengthening, relatively fast consolidation could be observed, whereas healing is slower in the tibia.

Congenital, Syndromes, Skeletal Dysplasias

**EP-072**

**Miserable malalignment syndrome in children – a systematic review and case series**

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**Level IV**

***Introduction and Objective*** Miserable malalignment syndrome is a condition causing significant functional and cosmetic abnormality and is a known cause of refractory anterior knee pain. The aim of this study is to systematically review current literature; establish a common ground to its management; present our case series report on the latter.
***Materials and Methods*** The electronic MEDLINE, EMBASE, Cochrane databases were searched for original articles with keywords including miserable malalignment syndrome, torsional deformity of the lower limb, femoral anteversion with persistent external tibial torsion, increased femoral anteversion, torsional malalignment syndrome, torsional abnormality, limb alignment surgery and medial femoral torsion. We also prospectively reviewed our case series, three patients (five lower limbs) that underwent surgical deformity correction. Pre and postoperative version angles were measured and Lysholm scores recorded.
***Results*** Forty-eight studies were identified, of which four analysed cerebral palsy torsional deformities, nine described femoral osteotomies only, five tibia, while four studies focused on both femoral and tibia torsional malalignment correction with interest to our study. Preoperative femoral version mean was 44.33 and tibia 43.16. Postoperative versions were measured to 14.16 for the femurs and 13.16 for the tibias. Preoperative Lysholm scores mean was 49.8 and post operative was 99.4.
***Conclusions*** Persistent femoral anteversion associated with external tibial torsion are first managed by conservative means, with poor results after the age of seven. Although the patella and extensor mechanism may seem as the culprit behind the pathology, it is actually only the end result of the proximal and distal torsional abnormalities. Surgical treatment represents a good and safe option for these cases.

Congenital, Syndromes, Skeletal Dysplasias

**EP-073**

**High prevalence of tethered cord and neuraxis abnormalities in Costello syndrome (CS)**

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**Level IV**

***Introduction and Objective*** Costello syndrome (CS) is a rare RAS-MAPK pathway disorder related to Neurofibromatosis and Noonan syndrome. Patients with CS are known to have an increased prevalence of Chiari I malformations and extensive musculoskeletal manifestations. Study aim was to study the prevalence of other neuraxis anomalies in CS patients.
***Materials and Methods*** This was an IRB approved retrospective cross-sectional review of clinical and imaging data of 48 patients with CS. Prevalence of spinal cord anomalies analyzed included tethered cord diagnosis made for the conus lying below L3 and transitional vertebrae.
***Results*** Tethered cord was seen in 17/34 spine MRI's reviewed. 8/14 of these patients underwent surgery for tethered cord release with improvement in symptoms. 3 patients needed repeat releases. Most patients with a tethered cord had a G12S mutation (most common mutation associated with CS). Other neuraxis abnormalities included Chiari I malformation (13, 16%) and Syringomyelia (6, 17%). Spine MRI's (5/29) revealed the presence of 6 lumbar vertebrae.
***Conclusions*** The prevalence of tethered cord (50%) in this population is very high compared to the normal population, suggesting the need for full spine MR imaging. Also, given the fact that many of these patients have 6 lumbar vertebrae, it is important to count vertebral levels from the top down to accurately localize the tip of the conus and make the correct diagnosis of a tethered cord. All spine MRI's need to have at least a scout with the entire spine to enable appropriate numbering from the cervical spine down. Appropriate clinic-radiologic correlation of musculoskeletal and neuraxis abnormalities may aid in appropriate treatment selection in these patients.

Congenital, Syndromes, Skeletal Dysplasias

**EP-074**

**Surgery in arthrogrypotic patients according to classification improves knee range of motion**

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**Level III**

***Introduction and Objective*** The purpose of this study was to develop a hip and knee contracture classification to guide treatment in arthrogrypotic patients.
***Materials and Methods*** Arthrogrypotic patients were classified according to types of knee contractures: type 1 - flexion contractures, type 2 -extension contractures, and type 3 -combined flexion and extension contractures, with a hip modifier. Treatment for type 1 included posterior knee release and proximal femoral shortening, for type 2 included a quadricepsplasty, anterior release, and proximal femoral shortening, and type 3 included both a quadricepsplasty, posterior release and femoral shortening. Pre- and post-operative knee range of motion was compared.
***Results*** Twelve patients (age: 6 yrs. ± 4 yrs.) were analyzed for each affected limb (n = 20). In type 1, knee ROM increased from 44 ± 25° to 79 ± 12° ($p$ = .005). All patients achieved full extension. In type 2, knee ROM increased from 29 ± 31° to 78 ± 8° ($p$ = .010). In type 3, knee ROM increased from 35° to 90°, statistics were not calculated due to small sample size (n = 3). Ten patients achieved independent ambulation and two achieved ambulation with an assistive device.
***Conclusions*** Knee range of motion can be increased through surgical intervention with the largest increases seen in type 1. We found that hip flexion and extension contractures were successfully treated with soft tissue releases and proximal femoral shortening at the same time. The hip abduction contracture most often resolved in the postoperative period with physical therapy. This classification enabled us to stratify each affected limb to the appropriate treatment and achieve an increase in knee range of motion. Further study will include long term follow up and quality of life measures.

DDH

**EP-075**

**A prospective study to assess the clinical impact of interobserver reliability of ultrasound enhanced physical examination of the hip**

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**Level II**

***Introduction and Objective*** To determine the reliability of performing ultrasound enhanced physical examination (UEPE) of infant hips. The technique of ultrasound enhanced physical examination of the hip allows one of four possible outcomes: normal, dysplastic, unstable and dislocated. It can also be reported in binary form as having either a normal or abnormal outcome.
***Materials and Methods*** 227 infants underwent UEPE of the hip by one of two different examiners; one was an experienced clinician (considered the gold standard for this study) and the other was one of 3 different providers: a pediatric orthopedic fellowship trained surgeon, a fifth-year orthopedic surgery resident and a pediatrician. All of the second examiners were trained by the senior examiner. The examinations were performed on the same day but independent of each other. The results were then analyzed by a third independent blinded reviewer, who was familiar with the technique, to determine agreement amongst the examiners. Inter and intra observer reliability was measured with intraclass correlation coefficient (ICC) using one-way ANOVA, where a result of 1 represents perfect agreement and 0 represents no agreement.
***Results*** Of the 227 patients (454 hips) there were 18 dislocations, 24 unstable hips and 63 dysplastic hips (as graded by the gold standard examiner). The ICC between the gold standard and the other examiners for all hips was 0.915 (p=0.001). When adjusting for only a binary outcome of "normal" versus "abnormal" hips the ICC was 0.97 (p=0.001).

***Conclusions*** Ultrasound enhanced physical examination of the hip was easy to learn and perform and proved to be reliable and have low variability, especially when reported as a binary outcome of normal or abnormal.

Foot

**EP-076**

**Does familial clubfoot have worse course and outcomes than non-familial clubfoot?**

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**Level III**

***Introduction and Objective*** Isolated Clubfoot has mild familial tendency. Clubfoot has an unknown etiology and an unclear relationship to certain genes. On top of an increased rate of familial occurrence, it has been suspected that familial (isolated) clubfoot demands longer treatments while delivering less favorable outcomes. We sought to evaluate if familial clubfoot has the same features and responds to the standard (i.e. Ponseti) treatment as non-familial.
***Materials and Methods*** Data regarding the clinical course of treatment for 24 babies with familial history of clubfoot were compared to that of 65 babies with non-familial clubfoot. The babies were grouped so each familial case was paired with 2-3 non-familial control patients with the same sex and birth year.
***Results*** Certain features were more common in familial cases, including bilateral clubfeet (66% vs. 39%) and atypical features (27% vs. 6%). The mean number of casts needed for correction was slightly higher (7.2 vs. 5.9) in familial cases, and an indication for Achilles tenotomy was higher (100% vs. 82%) as well. Further evaluation revealed a higher need for re-tenotomy (47% vs. 6%), and for additional treatments (53% vs. 9%) in familial clubfoot.
***Conclusions*** The differences in treatment, although statistically significant, do not represent a major deviation from the standard early Ponseti protocol. Nevertheless, they may show a substantial difference in the nature of clubfoot in each group. Familial clubfoot probably represents a more severe type of disease. Although a genetic cause of clubfoot has not been elucidated, these findings support the assumption that an inherited characteristic is involved in the etiology of clubfoot and may in fact offer a worse prognosis.

Foot

**EP-077**

**The value of standard x-rays in Ponseti treated clubfoot**

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**Level II**

***Introduction and Objective*** Since clubfoot are more and more treated with the Ponseti method the last decades, X-rays do not have a role anymore in guiding the surgical steps in treatment as they did before. Despite this change in treatment, X-rays are still made as part of standard care in our hospital. In this study we investigated if X-rays during the Ponseti treatment have a value in predicting additional, surgical treatment.
***Materials and Methods*** In this prospective follow-up study we included all children with clubfoot treated in our hospital (Sophia Kinderziekenhuis, Rotterdam, the Netherlands) from June 2012 till June 2014 with the Ponseti method. X-rays were made at the age of three months. Two independent orthopaedic surgeons did measurements on these X-rays to quantify variants in anatomy like parallelism and equinus. Follow-up was 4 to 6 years.
Results were expressed by the need of additional surgery. There were three groups; no surgery, extra-articular surgery (conform Ponseti treatment) and posteromedial release. We investigated the relation between the radiological measurements and the additional treatment groups.
***Results*** We included 54 children with 78 clubfeet. In 23 clubfeet additional extra-articular surgery was performed, no clubfoot underwent a posteromedial release. A smaller lateral tibiocalcaneal angle was associated with lesser additional, surgical treatment ($p<0.05$).
***Conclusions*** A smaller lateral tibiocalcaneal angle predicts less additional surgical treatment in Ponseti treatment of clubfeet. Because this angle is a measure for the length of the Achilles tendon, which can be assessed clinically, an X-ray does not add any extra information. Therefore, we conclude that making standard X-rays of Ponseti treated clubfoot at the age of three months is not of any clinical use.

Foot

**EP-078**

**The validity of patient reported outcome measurement information system (PROMIS) parent proxy instruments to assess function in children with talipes equinovarus**

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**Level II**

***Introduction and Objective*** Idiopathic talipes equinovarus (ITEV) is a prevalent foot/ankle deformity in children. Disease Specific Instrument (DSI) has commonly been used as an outcomes metric in these patients. Patient-Reported Outcomes Measurement Information System (PROMIS) was developed to examine quality of life across various medical conditions. The purpose was to examine validity of the PROMIS in children with ITEV.
***Materials and Methods*** Prospective analysis was performed by mailing two questionnaires to parents of 91 patients, aged

5-17 years, with ITEV. Construct validity of PROMIS Parent Proxy Profile short forms version (v2.0-Profile-37) was assessed by comparing its domains of Mobility, Fatigue, Pain Interference and Pain Intensity to DSI Function domain and PROMIS domains of Anxiety, Depressive Symptoms, Peer Relationships and Pain Intensity to DSI Satisfaction domain.
***Results*** Thirty-one responses (34%) were returned. Bivariate correlation analysis, using Spearman correlation coefficients, demonstrated a moderate positive correlation between DSI Function and PROMIS Mobility ($r_s$=0.52) and a moderate negative correlation between DSI Function and PROMIS Pain Interference ($r_s$=-0.56), and PROMIS Pain Intensity ($r_s$=-0.75). A fair negative correlation ($r_s$=-0.38) with PROMIS Fatigue was found. Correlation coefficients ($r_s$) between DSI Satisfaction and PROMIS Anxiety and Depressive Symptoms were both -0.11 (little relationship), PROMIS Peer Relationships was 0.42 (fair) and PROMIS Pain Intensity was -0.49 (fair).
***Conclusions*** Results provide support for validity of PROMIS Mobility, Pain Interference, and Pain Intensity domains in this population, however no items in PROMIS can assess overall satisfaction, as with DSI. PROMIS Parent Proxy Profile does not appear to fully substitute for the DSI for outcomes scoring in children with ITEV.

Foot

**EP-079**

**Does size matter: foot size in clubfoot**

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**Level II**

***Introduction and Objective*** Severity of clubfoot at presentation is difficult to assess. Classification system as Pirani and Dimeglio are not always accurate in predicting the severity and response to treatment. One of the finding in club foot is the reduced foot size. Does smaller foot is more severely involved?
***Materials and Methods*** In a prospective study foot length and circumference were measured by two independent surveyors of all newly presented newborns with idiopathic clubfoot before first casting. Number of casts needed for correction, functional score at last visit, the need for tenotomy and the relapse rate, measured by surgical procedures were recorded. Foot measurements were adjusted for gestational age. Data collected with follow up of at least 2 years (2-5y) was analyzed using SPSS Pearson correlation.
***Results*** 52 children with 73 feet were included. The mean foot length was 7.3cm (5.7-9), the mean number of casts change was 6.9 (4-11). The mean Pirani score was 5.5(2.5-6), the mean functional score was 125 points. (53-145). The relapse rate as measured by operation such as TATT was 15% (11/73). We found correlation between foot length to the number of cast changes needed for correction, and to the Pirani score, p<0.05. Children with foot length shorter than 8cm had 7.3 cast changes (4-11). Compare to feet longer than 8cm, 4.7 cast change (4-6), p<0.001.
***Conclusions*** foot dimensions at presentation play an important role in clubfoot treatment. Clubfoot severity may be reflected by a smaller foot size and may create problems in casting and manipulation. Feet shorter than 8cm may need more casts changes.

Foot

**EP-080**

**Effects of body weight on the clinical and radiological outcomes of children with flexible flatfeet managed with the "calcaneo-stop" procedure**

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**Level IV**

***Introduction and Objective*** Flexible flatfoot (FFF) is a widespread condition and, if symptomatic, FFF can require surgical treatment. The calcaneo-stop procedure (CSP) has shown excellent clinical and radiographic outcomes. This study aimed to evaluate the outcomes of normal, overweight, and obese children with symptomatic FFF managed with the CSP.
***Materials and Methods*** 174 symptomatic FFF were managed with CSP were divided into three groups according to WHO BMI-for-age: normal, overweight, and obese. Clinical evaluation, including using the American Orthopedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score, the Foot and Ankle Disability Index (FADI), and the Short Form 36 (SF-36) were assessed. Radiographic evaluation was based on measurement of Kite's angle, Costa-Bertani's angle, talar declination, and calcaneal pitch.
***Results*** Although the radiographic criteria were comparable between the three groups. 1 year after surgery, the clinical scores were worse in the obese patients and revealed an increased persistence of pain. 5 years after surgery, no significant differences were found.
***Conclusions*** BMI and Z-score affected the outcomes of obese patients treated with CSP for symptomatic flexible flatfeet. Obese patients had significantly lower clinical scores than the other patients.

Hip

**EP-081**

**Comparison of direct and indirect measurements of pulse in the proximal femoral epiphysis using an intracranial pressure monitoring probe**

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**Level IV**

***Introduction and Objective*** Open reduction surgery of severe cases of slipped capital femoral epiphysis (SCFE) guided by an intracranial pressure (ICP) monitoring probe inserted in the femoral head is a promising new technique. It has also been proposed to do closed reduction (CR) of acute SCFE (the condition that carries the highest risk of avascular necrosis) aided by monitoring pulse in the femoral head using ICP probes inserted through cannulated screws. However, little is known about the actual relationship between different approaches to monitor pulsatile flow in the femoral head. A study was designed to compare direct and indirect techniques for monitoring pulse in the femoral head in an experimental animal model.
***Materials and Methods*** Animal model using anesthetized pigs with an immature femoral head. Perfusion of the femoral head was confirmed by a preoperative gadolinium MRI scan. The following measurements were performed using the Codman ICP probe on 9 hip joints; direct measurement using 1.5 mm drill hole and indirect measurements through joint aspiration cannula, 4.5 mm cannulated screw and 6.5 mm cannulated screw. Direct measurements were performed through a drill hole in the adjacent metaphysis.
***Results*** Pulsatile flow was observed on all measurements. Groups were tested using ANOVA. Pressure was significantly higher using the direct approach (31.6 mmHg) to the femoral head compared to indirect techniques (6.7 - 13.7 mmHg). We were unable to find any difference between the different indirect techniques.
***Conclusions*** Indirect monitoring through cannulated screws may have a limited role for CR of acute SCFE. Because of the more reliable direct monitoring technique we advocate that CR is only undertaken in a setting where conversion to surgical dislocation and direct monitoring of pulse in the femoral head can performed.

Hip

**EP-082**

**Hip survival after treatment of avascular necrosis after slipped capital femoral epiphysis is dependent on degree of femoral head involvement**

**Michael Millis*** [1]; James Wylie[1]; Mariana Ferrer[1]; Eduardo Novais[1]; Patricia Miller[2]

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**Level IV**

***Introduction and Objective*** To investigate treatment outcomes in patients with avascular necrosis (AVN) after treatment for slipped capital femoral epiphysis (SCFE).
***Materials and Methods*** We retrospectively reviewed patients treated for AVN after SCFE. Noted were age, gender, SCFE severity, acuity, original treatment and secondary surgery. Radiographs were evaluated for arc of collapse of epiphysis (NA) at diagnosis and Tönnis OA grade at followup. Intra- and interrater reliability of the arc of necrosis (>90 degrees vs <90 degrees) of femoral head was evaluated by Cohen's kappa. Modified Merle D'Aubigne scores were noted at follow-up. Predictors of failure (arthrodesis, hip arthroplasty, or Tönnis OA grade>3) were investigated.
***Results*** 92 patients were treated for AVN after SCFE. 37 patients (40%) had complete clinical and radiographic data. Last follow-up was mean 12 years. Cohort was 54% male. Patients were followed minimum of 1 year or to failure. There was no difference in patient age, sex, SCFE severity, stability, or procedure type across head necrosis groups. By 10 years postop, 70% of hips with NA<90 survived. Only 20% of hips with NA>90 had survived. At most recent follow-up, 20 patients (64%) had failed: 1 arthrodesis, 10 THA, 9 with Tönnis grade>3. Of NA<90 hips, 30% still were functioning. Of NA >90 hips, hips, 88% failed by 5 years postop, 100% by 15 years. Hips with >90 degrees had 20 times odds of failure (OR 20.7, p>0.001). There was no association between failure and patient sex, age, SCFE severity, stability, or procedure type (p>0.56). Kaplan-Meier analysis determined hips with>90 degrees arc of necrosis had significantly higher failure risk (P>0.001).
***Conclusions*** In hips with AVN following SCFE, arc of femoral head collapse predicts duration of hip survival to fusion, THA, and severe radiographic OA.

Hip

**EP-083**

**Treatment of hips with avascular necrosis after slipped capital femoral epiphysis by flexion intertrochanteric osteotomy**

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**Level IV**

***Introduction and Objective*** Hips with SCFE which develop AVN historically have a very poor prognosis, with osteoarthritis and dysfunction the expected outcome. Flexion intertrochanteric osteotomy (FITO) has been used to salvage certain hips with AVN-related deformity after SCFE. The goal of our retrospective review of our large SCFE institutional database was to evaluate outcomes after FITO and to identify factors associated with relative success or failure.
***Materials and Methods*** IRB-approved review of our institutional database identified 16 hips with AVN after SCFE treated by FITO between 1994 and 2014. Review of records noted primary treatment, acuity of original symptoms secondary

treatment, function by Merle D'Aubigne score. Image review noted degree of original SCFE, and arc of necrosis (ARC), measured on AP and lateral radiographs. 13/16 hips had severe SCFE (>45°); 14/16 were unstable. Failure was defined as total hip replacement, hip fusion, or osteoarthritis with Tonnis OA grade>3.
***Results*** At follow-up of 2 to 19 y (mean 11), 8 hips were still functioning. 8 had failed—4 had total hip replacement, 1 had fusion, and 3 had endstage OA with Tonnis OA grade 4. Hips with ARC<90° had median survival 11 y, compared with median survival only 2.8 y in hips with ARC>90°. No other factors were identified to predict failure after FITO.
***Conclusions*** Flexion intertrochanteric osteotomy can be effective in maintaining hip function in hips afflicted with AVN after SCFE. Hips with ARC<90° seem more likely to benefit from the procedure than hips with more severe head deformity.

Hip

**EP-084**

**Isolated trochanteric descent and greater trochanteric apophyseodesis are equally inefficient in the treatment of post-Perthes deformity**

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**Level IV**

***Introduction and Objective*** We sought to determine the effect of greater trochanteric apophyseodesis and of isolated greater trochanteric descent on the radiographic result and the strength of the gluteus medius in patients with sequelae of Legg-Calvé-Perthes disease (LCPD)
***Materials and Methods*** a retrospective study, determining the neck-shaft angle, the neck length, the Stulberg classification and the strength of the gluteus medius for 12 patients who had undergone isolated greater trochanteric descent and 11 patients who had undergone a greater trochanteric apophyseodesis (as the only surgical treatment for sequelae of LCPD. Minimum follow up was 6 years from the time of surgery. Compared to a matched cohort of 20 patients undergoing no surgical treatment.
***Results*** 12 patients underwent trochanteric descent, 8 resulted in a Stulberg type III hip, 2 a type II and 2 a type IV, the mean neck-shaft angle for this group was 122º (range 118-134º), neck length was 22mm (range 18 to 28), strength of the gluteus medius was 3.5/5, change in neck shaft angle was -12º. 11 patients underwent a greater trochanteric apophyseodesis, 8 resulted in a Stulberg type III hip, and 3 a type II, the mean neck-shaft angle was 119º (range 110-130º), neck length was 23mm (range 17 to 30), strength of the gluteus medius was 3.0/5, change in neck shaft angle was -18º. 20 matched patients who underwent no surgical treatment, 16 resulted in a Stulberg type III hip, 2 a type II and 2 a type IV, the mean neck-shaft angle for this group was 126º (range 116-133º), neck length was 23mm (range 17 to 29), strength of the gluteus medius was 3.5/5, change in neck shaft angle was -5º.
***Conclusions*** Neither greater isolated trochanteric descent nor greater trochanteric apophyseodesis had a significant effect on the morphology of the hip or the strength of the gluteus medius.

Hip

**EP-085**

**Complications related to the use of Hansson pins in the in-situ fixation of slipped capital femoral epiphysis – a 12-year experience**

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**Level IV**

***Introduction and Objective*** Percutaneous fixation is the mainstay of treatment in slipped capital femoral epiphysis. There are complications intrinsic to the type of implant used for fixation.
***Materials and Methods*** We reviewed in a retrospective study all consecutive patients (n=60, 107 hips) treated between 2004 and 2016 with a Hansson hook pin. They were analysed for implant-related complications such as implant misplacement, intraarticular protrusion, secondary epiphyseal slipping, implant breakage, femoral head necrosis, femoral fracture, and hardware-related pain. The results were compared to the literature.
***Results*** 41 Patients were male (68%), 19 were female (32%). Mean Body mass index was 25 (SD 3.2). Mean age at surgery was 12.1 years (12.5 for male, 11.2 for female). Mean follow up was 34 months (4-84 months). There were 16 complications in 16 patients (15% of the hips) of which six complications where on the prophylactic side. There was one misplaced pin, two intraarticular pin protrusions, one breakage of an implant part, two secondary displacements of the epiphysis, one femoral head necrosis, five fractures, and four pins causing pain. All patients with fractures (n=5, all male; two on prophylactic side) had a fall that occurred after a mean of 53 days postoperatively, three within the first 14 days. There was no correlation between the height of the entry-point in relation to the lesser trochanter, the length of the pin to the extraosseous overlap of the implant, and no association between the angle of insertion to the occurrence of a fracture.
***Conclusions*** Complications are surprisingly frequent in Hansson Pin use. Early falls have been identified as the major risk factor for fractures.

Infection

**EP-086**

**Brodie's abscess - a review of current management following an atypical presentation in a distal radius fracture managed with percutaneous Kirschner wire fixation**

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**Level IV**

***Introduction and Objective*** Chronic osteomyelitis complicating percutaneous Kirschner-wire (K-wire) fixation of distal radius fractures in children is uncommon. We present an unusual case where a paediatric patient developed a Brodie's abscess ten months after initial management with a K-wire fixation for a distal radius fracture which caused significant morbidity and required surgical intervention.
***Materials and Methods*** Case Report: 8-year-old with a Salter Harris II type fracture who underwent manipulation under anaesthesia and K-wire fixation. K-wires removed at 4 weeks post operation; there was no evidence of pin site infection whilst the K-wire was in-situ, or following removal. 10 months after initial presentation patient had reoccurrence of pain and swelling. Brodie's abscess was confirmed following radiographs and magnetic resonance imaging; the patient underwent a successful surgical curettage and a 6-week regime of intra-venous teicoplanin.
***Results*** A literature review identified 141 papers associated with Brodie's abscess; of these 1 paediatric case was identified as associated with the distal radius following operative intervention. The paper reviewed a 16-year-old male who developed Brodie's abscess 5 years after surgical intervention. This case was managed with surgical curettage and intravenous antibiotics. The patient had a complete recovery.
***Conclusions*** We aim to highlight the dangerous rare complication of a commonly performed surgical treatment, percutaneous K-wire fixation of the distal radius, in a paediatric age group. Even in the absence of a pin site infection, a delayed presentation of a Brodie's abscess is still possible. If a patient develops a Brodie's abscess as a complication the general consensus among the published material is surgical curettage, bone grafting and appropriate post-operative antibiotics.

Spine

**EP-087**

**The Internet, social media and magnetically controlled growing rods: what do our patients see online?**

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**Level IV**

***Introduction and Objective*** Patients' families use the Internet to search for health information. Magnetically controlled growing rods (MCGR) are increasingly being used in patients and have much attention from the public. The quality of online information has not been assessed.
***Materials and Methods*** Using search terms "magnetic growing rods," we assessed the top 20 links on each of: Google, YouTube and Facebook. Links were classified by content and source. Each was rated by three pediatric orthopaedic surgeons using the previously validated DISCERN criteria for reliability and Global Quality Scale for overall quality. Analysis was done using linear regression and one-way ANOVA.
***Results*** Medical institutions created 55% of the links, patients/parents created 25%, and news media created 12%. Only 58% of the sources mentioned treatment alternatives. Links from industry had the highest scores and links from patients had the lowest scores for global quality ($p = 0.00$) and overall reliability ($p = 0.00$). Industry scored lower than professionals and media in lack of bias ($p = 0.003$). Google had the highest scores for global quality ($p = 0.02$), overall reliability ($p = 0.002$), lack of bias (0.03) and was most likely to provide additional sources of information ($p = 0.001$). 80% of links containing misinformation were found on YouTube. Half of YouTube links were demonstrations of surgery or lengthenings. 65% of Facebook links were personal posts.
***Conclusions*** Many patients and their families will turn to online sources for information about MCGR. We found that patients may benefit from focusing on sources created by professionals and found on Google (i.e. the general Internet) compared to social media, but need to be wary and have thorough discussions with their surgeons.

Spine

**EP-088**

**Touched vertebra (TV) on standing x-ray is a good predictor for LIV. TV on prone x-ray is better**

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**Level II**

***Introduction and Objective*** Minimizing the fusion levels in PSF for AIS is important. Previous studies have shown good results utilizing TV as the lowest instrumented vertebra (LIV). TV is the vertebra touched by central sacral vertical line on standing AP XRs (TVS). Utilizing TV on prone XRs (TVP) in LIV decision making may allow even shorter fusion.
***Materials and Methods*** Three groups: Group I: patients where TVP was used to determine LIV, Group II: patients where TVS was used to determine LIV, Control: non-operative AIS to determine 'acceptable' end vertebra tilt and disc wedging. Pt's with only thoracic fusion were excluded. Chart and XR were reviewed. Radiographic parameters were collected at preop and postop. Median values and IQR were collected for the subsets. Wilcoxon and Kruskal-Wallis test were used.
***Results*** Control group had 132 patients with a median (IQR) Cobb of 20°, age of 16, coronal balance 1.4, disc wedging of 4° and LIV tilt of 10°. In Group 1, median preop Cobb was 53.8° and coronal balance was 1.8. Final Cobb was 12.4° and coronal balance was 0.9. Compared to controls, Group I pt's significantly less coronal imbalance ($p =0.023$) lower disc wedging ($p>0.001$) and LIV tilt ($p<0.001$). In Grou 2, preop

Cobb was 53.5° and coronal balance was 2. Final Cobb was 20° and coronal balance was 0.7. Group 2 pt's could have saved an average 2.24 levels, if fused to TVP.
***Conclusions*** In AIS, using TVP to determine LIV allows shorter fusion saving than TVS. Despite shorter fusion, coronal balance and correction is maintained, at final follow up with no adding on. LIV tilt and disc wedging is also within 'acceptable' levels determined on controls.

Spine

**EP-089**

**Minimally invasive surgery in neuromuscular scoliosis: a superior approach for severely impaired patients**

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**Level II**

***Introduction and Objective*** Minimally invasive surgery approach has been shown to decrease blood loss, pain, transfusion rate and hospital stays in adolescent idiopathic scoliosis (AIS) patients. This approach has never been reported on NM patients, who have multiple complications and can benefit greatly from this technique. This study seeks to compare the perioperative outcomes of MIS approach to standard PSF approach in neuromuscular patients.
***Materials and Methods*** XR review of NM scoliosis patients operated on from 2005-2017 by a single surgeon. PSF was performed from 2005-2016. MIS approach was adopted in 2014. Perioperative outcomes such as length of operation, transfusions, neuro-monitoring signal changes, EBL, and length of stay were recorded. Pre- and postop XR were reviewed for Cobb angle, kyphosis, levels fused and pelvic obliquity. Median and IQR were calculated for non-normative distributions and Fisher's exact test and Wilcoxon Rank Sums tests were used.
***Results*** 158 NM scoliosis patients underwent surgery between 2005-2017. Patients were of similar age, preop Cobb angle, and preop pelvic obliquity. PSF patients had significantly longer surgeries ($p = 0.017$). EBL was significantly higher in PSF ($p < 0.0001$). Postop Cobb, and postop pelvic obliquity were similar. MIS had more levels fused and complication rates were smaller in MIS, but not significant. MIS has significantly shorter hospital stays ($p=0.001$).
***Conclusions*** Minimally invasive approach provides comparable results for postop Cobb, pelvic obliquity, as well as the greatest benefits to patients in terms of decreased complications, blood loss, surgery length, and hospital stay. MIS should be strongly considered in this group of complex patients.

Spine

**EP-090**

**Intraoperative CT-guided navigation reduces pedicle screw malposition**

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**Level III**

***Introduction and Objective*** We sought to analyze screw malposition and return to OR comparing screws placed with, and without, CT-guided navigation.
***Materials and Methods*** All patients under the age of 18 who underwent pedicle screw instrumentation between 2009 - 2015 at a single, high-volume pediatric spine center were included. IRB-approval was obtained and patient charts as well as images were reviewed for patient demographics, surgical outcomes, and implant position. If available, incidental CTs following the index surgery were reviewed to assess screw position.
***Results*** 389 patients aged 18 or younger underwent spinal instrumentation between 2009 - 2015. Two hundred twenty patients had pedicle screws placed using low-dose intraoperative CT-guided navigation, while 169 patients had pedicle screws placed using alternative methods without navigation. Patients in each group had a similar number of levels fused (10.6 vs. 10.3, $p = 0.56$). There was no difference in estimated blood loss (1286 vs. 1108 mL, $p = 0.09$), and there was no difference in operative time when controlling for number of levels fused (57.1 vs. 56.9 minutes/level, $p = 0.96$). Postoperative CTs were available in 75 patients imaging 768 screws, which showed that CT-guided navigation resulted in a significantly lower rate of severely malpositioned (>4mm) screws (0.5% vs. 3%, $p = 0.005$), and a significantly lower rate of return to the OR for screw malposition (0% vs 2.4%, $p = 0.02$) when compared to alternative methods.
***Conclusions*** The use of intraoperative CT-guided navigation resulted in a lower rate of severely malpositioned pedicle screws and eliminated return to the OR for screw malposition in a complex cohort of pediatric spinal deformity patients with no increase in blood loss or operative time.

Spine

**EP-091**

**Pathologic sagittal alignment is already present in early stages of adolescent idiopathic scoliosis (AIS)**

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**Level II**

***Introduction and Objective*** AIS is a complex 3-D deformity characterized by lateral deviation and regional rotated lordosis of the apical zones. In the anatomical, mid-sagittal plane this structural deformation leads to modifications of the global thoracic kyphosis. Recent introduction of a classification

system for sagittal morphology of the scoliotic thoracic spine demonstrated 4 different patterns of loss of kyphosis in severe AIS. The aim of this study is to define the starting point of the sagittal pathological patterns in AIS and compare it to the non-scoliotic population.
***Materials and Methods*** Sagittal spinal morphology was studied in mild (n=191, 10-20°) and severe (n=161, >45°) AIS patients in an international consortium, using the validated Abelin-Genevois classification. Sagittal patterns were compared to normal adolescents (n=156), stratified to before, at or after the adolescent growth spurt. Outcomes were the epidemiology of sagittal curve types, T4-T12 and T10-L2 angle, C7 slope, location of the inflection point.
***Results*** In mild thoracic AIS, already 55% of the curves present as a thoracic hypokyphosis, whereas 13% of mild (thoraco) lumbar curves have a pathological thoracic alignment. In severe thoracic AIS, 65% had a pathological sagittal profile, mostly thoracic hypokyphosis. Of the severe primary lumbar curves, 45% had thoracic hypokyphosis, of which 2/3 also had a thoracolumbar hyperkyphosis. Only 6% of the normal adolescent had thoracic hypokyphosis.
***Conclusions*** Pathological sagittal patterns are often already present in AIS at the earliest stage of AIS, whereas those are rare in normal adolescents. This suggests that sagittal 'malalignment' is an integral part of the development of scoliosis and that, also at an early stage of AIS, treatment should address the sagittal malalignment component of the disease.

Spine

**EP-092**

**Spinal infections in AIS and neuromuscular scoliosis. Are MRSA Nares cultures predictors of trouble to come?**

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**Level III**

***Introduction and Objective*** Infections after PSF is a rare but significant. Infections with MRSA makes these even more overwhelming. The purpose of our study was to review our series and also evaluate the usefulness of performing preoperative nasal MRSA cultures as a risk factor for the development of infection.
***Materials and Methods*** 537 spinal procedures were identified and demographic data collected. Nares cultures for MRSA and the results were recorded and compared to the database for presence or absence of spinal infection and organisms. 332 patients were prior to Nares cultures.
***Results*** We had Nares cultures for 205 patients. 193/205 cultures were negative and 12 positive (5.8%). 4/12 developed an infection, two of those were MRSA. 12/193 patients without positive Nares cultures developed an infection (6.2%), 2/12 became MRSA infections. 14 infected neuromuscular patients with positive nares cultures: 4 positive, 10 negative; 5 were prior to Nares cultures. Of the 4 positive for MRSA, 2 were infected with MRSA despite MRSA decolonization. 2 patients infected with MRSA were negative on the Nares cultures. However, one of the negative Nares cultures developed the MRSA infection, 192 days post op after undergoing a hip procedure that became infected with MRSA.
***Conclusions*** There is a higher incidence of wound infections in neuromuscular patients. All MRSA infections in our series developed in the neuromuscular population. Surprisingly, patients who developed infection had similar surgical times and lesser blood loss. The nasal cultures did not seem predictive for infection risk. However, positive MRSA cultures in the nares correlated with deep wound infection with MRSA.

Trauma

**EP-093**

**Satisfactory fracture reduction can be achieved using the single-pulse mode on the C-arm image intensifier**

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**Level III**

***Introduction and Objective*** When a C-arm image intensifier is used for fracture reduction, it is usually set to auto mode, where a significant amount of radiation is emitted. Few studies have determined the efficacy of fracture reduction using the single-pulse mode. This study aims to retrospectively review the efficacy of using the single-pulse mode on a C-arm image intensifier when reducing supracondylar humerus fractures (SCHF), which is a common fracture with well-defined and measurable treatment outcomes.
***Materials and Methods*** 60 patients with an average age of 6.1 ± 2.5 years underwent closed reduction and percutaneous pinning (CRPP) of a SCHF in a single institution, over a period of 19 months. Of these, the II machine was set to auto mode (group A) and single-pulse mode (B) for 30 patients each.
***Results*** The average intra-operative post-reduction Baumann angle was measured to be 72.5 ± 3.6 (range 66-80) for group A, and 74.3 ± 3.1 (range 68-79) for group B (p=0.065). These are both within satisfactory limits. The average intra-operative timing was 21.6 ± 11.1 min (range 8-58) for group A, and 21.9 ± 10.5 min (range 7-44) for group B (p=0.796). The average radiation exposure was 35.2 ± 31.8 cGycm$^2$/min for group A, which was 20.0 cGycm$^2$/min higher (p=0.001) than that of group B (15.11 ± 3.6 cGycm$^2$/min).
***Conclusions*** Satisfactory fracture reduction can be achieved using the single-pulse mode on the C-arm image intensifier, which significantly reduces the radiation exposure to patients and the surgical team, while maintaining similar operative outcomes.

Tumours

**EP-094**

**Giant cell tumour of tendon sheath: report on six patients**

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**Level IV**

***Introduction and Objective*** A giant cell tumour of tendon sheath (GCTTS) is a soft tissue, benign, locally aggressive tumour consisting principally of a proliferation of synovial cells arising from a tendon sheath, bursas, and joints. Malign alteration is rare. GCTTS is the second most common tumour of the hand in general and a majority of GCTTS cases are in patients between 20 and 50 years of age, whereas pediatric cases of GCTTS are uncommon. We want to show that they have to be thought of when children are concerned.
***Materials and Methods*** This report presents the series of retrospectively reviewed six patients, age 7-16 years, diagnosed and treated for GCTTS. The clinical examination report, age, gender, localization, presentation and size of tumour, pathohistological verification and treatment approach we got from patient's case record. We had three cases on the hand, two on the foot and one on the shin.
***Results*** In children, we noted similar predilection for lesions in both upper and lower extremities. Although the marginal excision is the treatment of choice, it is often difficult to perform due to the location and the strict adherence of the tumour to the tendon or neurovascular bundles.
***Conclusions*** Considering the rarity of this tumour in the pediatric population and the possibility of relapse (up to 15%), we consider that adequate surgical excision and complete tumour removal are important steps in reducing the rate of recurrence of this tumour.

Tumours

**EP-095**

**Combined plastic of bone cysts in children**

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**Level III**

***Introduction and Objective*** Size of cyst which is more than 2/3 diameter of bone, localization in weight area, high risk of pathological fracture, pain syndrome are indications for surgical treatment of bone cysts in children. There are certain techniques such as minimally invasive and open with resection of pathological area, but all of them have some disadvantages and complications. So the aim of the study is to estimate new surgical method which we developed in our hospital.
***Materials and Methods*** We analyzed results of treatment of 5 patients with bone cyst who were operated using combined plastic during the period from January to July 2018. Methods: anamnesis, clinical observation, standard laboratory and instrumental (X-ray, CN scan) methods, statistic.
***Results*** We operated 5 patients, all were female. Average age was 9 years. Bone cyst localized in left humerus (40%), left tibia (20%), right calcaneus (20%), right patella (20%). Pain syndrome was in 3 (60%) patients in cyst area. Pathological fracture in anamnesis was in patients with bone cyst which localized in humerus and tibia. All laboratory parameters were normal. Under X-ray control cyst was punctured, fluid was aspirated. Through puncture needles inner membrane was coagulated with high level laser irradiation (diode laser, 970 nm, 20 Vt). Then cavity was filled with crashed allograft and autogenic bone marrow. After operation for all patients we recommended cast immobilization during 4 weeks. Elimination of bone cavity and remodeling of bone tissue were in 3 months after operation.
***Conclusions*** Combined plastic of bone cyst is minimally invasive, minimally traumatic, very effective method. High-level laser irradiation destroys inner membrane, crushed allogenic bone graft is osteoconductor, bone marrow is osteoinductor.

Tumours

**EP-096**

**Proximal tibia reconstruction with osteotendinous allograft in pediatric patients affected by bone tumors: implant survival and functional outcomes of replaced patellar tendon**

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**Level IV**

***Introduction and Objective*** The use of a donor proximal tibia allograft, where has been preserved the patellar tendon, plus dedicated knee joint prosthesis, can improve knee function after reconstruction in young patients affected by malignant bone tumors of proximal tibia. The aim of this study is to evaluate the function of patellar tendon allograft in patients who underwent this surgery.
***Materials and Methods*** Nine patients, ranging in age from ten to twenty years old (average 13 years), who underwent surgical resection and reconstruction with a osteotendinous allograft, were retrospectively reviewed at a mean follow-up time of 36 months. Seven patients suffered from a high-grade sarcoma and two from Giant Cell Tumor of bone. Combined Knee Joint replacement and allograft was performed in 7 patients, only allograft in 2. Functional outcomes according to the Musculoskeletal Tumor Society Score and Knee Score Society were analyzed at the time of the latest follow-up. Complications were recorded and described.
***Results*** Eight patients are still alive. We achieved good results in relation to the MSTS score and the KSS score in 7 patients.

One deep infection, despite a good ROM, obliging us to remove the implant, was lost at follow-up. One patient had progression disease and died. One patient, suffered from tibia fracture, had second surgery and one suffered from paralysis of the external popliteal sciatic nerve and knee stiffness in extension.
***Conclusions*** Despite complications, the survival rate of the patellar tendon allograft was 100% at follow-up. The choice to use a well sized proximal tibial allograft with preserved patellar tendon is a valid option for limb salvage giving good results on knee function.

Upper Extremity

**EP-097**

**Lenghtening the ulna in patients with multiple hereditary exostoses**

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**Level IV**

***Introduction and Objective*** We are reporting the clinical-radiological results of ulnar lenghtening for patients with forearm deformity due to hereditary multiple exostoses (HME) Masada type I.
***Materials and Methods*** A retrospective observational study of HME Masada type I operated between 1994-2017 with minimum 1 year follow-up was performed. Two different methods were carried out: distraction osteogenesis (15 patients) and single time lengthening with bone graft (3 patients). Angular deformities of the forearm and wrist were evaluated. Forearm range of movement (ROM), cosmetic satisfaction, pain (VAS) and major-minor complications were also evaluated.
***Results*** 30 patients underwent surgery for HME with involvement of the forearm, of which 18 met inclusion criteria. Mean follow-up period was 7.47 years and mean external fixation time was 19 weeks (10-28 weeks). Distraction osteogenesis group improving pronation 62.3º to 75º and supination from 53.2º to 56.7º, without statistical significance. Radiologically, ulnar variance from -12.1 mm to -1 mm and carpal slip from 65.1% to 51.3% decreased at the end of the follow-up. Pin tract infection was observed in 40%. Recurrence of ulnar shortening in 2 patients (13%). In the single time group, all clinical parameters were modified, being statistically significant radial deviation from 0º to 32.5º and elbow flexion from 118º to 141.6º. Radiologically, the radial articular angle had a significant increase from 35.3º to 19.7º, as did the carpal slip from 45% to 25.7%.
***Conclusions*** HME affects the forearm frequently causing aesthetic deformity and limited ROM, without functional impairment. In HME type I of Masada, the resection of the osteochondroma associated with ulnar elongation is an effective technique for the correction of the deformity, either by progressive lengthening or in a single time.

Sports

**EP-098**

**Preliminary results of a new arthroscopic ACL repairing technique with bio absorbable anchor in proximal anterior cruciate ligament tears in skeletally immature patients**

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**Level IV**

***Introduction and Objective*** There is a significant risk of growth disturbance after ACL reconstruction in skeletally immature patients, in particular in Tanner stages 1-2, who have higher growth potential and consequently have a higher risk of major limb growth. We present our results with a new arthroscopic intra-articular ACL repairing technique with bioabsorbable suture anchor in patients Tanner 1-2 with proximal ACL tear.
***Materials and Methods*** Patients with Tanner stages 1–2 and proximal ACL tears with adequate tissue quality confirmed arthroscopically treated with suture anchor ACL reinsertion were included in the study. Clinical evaluation, KT-1000, International Knee Documentation Committee (IKDC), MRI and Lysholm and Tegner activity score were collected during follow-up.
***Results*** Twenty patients reached inclusion criteria. Mean age 9.8 years (range 4 to 10). Nine patients were excluded for the following reasons: follow up less than 1 year (4), re-rupture after new trauma (4) mean time from ACL repair was 5 years (range 1-9) and loss to follow up (1). Eleven patients were evaluated with follow up of 4,6 years (from 1 to 11). All of the patients described their knees as normal and had returned to their previous level of activity with good IKDC, Lysholm score and side-to-side difference. No patient complained other knee trauma or instability. None of the patients developed any axial deviation or leg length discrepancies. At MRI one lateral meniscal tear was observed in one of the four patients with ACL re-rupture. No other new articular lesions were reported.
***Conclusions*** This technique in selected skeletally immature patients shows good results in terms of joint stability and recovery of sport activity in such young patients.

Miscellaneous

**EP-099**

**Pediatric compliance of lower extremity weight bearing restrictions following injury**

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**Level III**

***Introduction and Objective*** Immobilization of certain lower extremity fractures required weight bearing restrictions to minimize the potential for displacement. In the adult population, 29% of patients have been found to be non-compliant following weight bearing restrictions, however, no such study has evaluated the compliance of non-weight bearing restrictions in the pediatric population. The goal of this study was to determine the compliance rate of weight bearing restrictions of immobilized lower extremity in the pediatric population.
***Materials and Methods*** A prospective study following twenty-seven patients ages 12 months to 17 years of age was performed to evaluate for weight bearing restriction compliance. A pressure sensitive film (Fuji Prescale Film, Sensor Products Inc., NJ, USA) was incorporated into the case beneath the heel pad within the webril soft padding. At the time of removal of the cast, the pressure sensor film was analyzed using standard analysis and compliance was recorded as a binary measure (compliant or non-compliant). Patients prescribed with non-weight bearing short leg casts and long leg non-weight bearing casts were included and analyzed.
***Results*** The majority of participants (23/27) were not compliant with their weight bearing restrictions independent of a short leg cast (n=10) or long leg cast (n=13). Of the four individuals who were compliant, all of them were prescribed long-leg casts. Fortunately, no patients lost alignment despite being non-compliant.
***Conclusions*** The compliance rate of weight bearing restrictions in pediatric patients following application of a lower extremity cast was only 15%. Further investigation into the need for weight bearing restrictions and better methods for compliance training in the population are needed.

Knee

**EP-100**

**Bioabsorbable pins in the arthroscopic treatment of anterior intercondylar eminence fracture in skeletally immature patients**

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**Level IV**

***Introduction and Objective*** When a knee sprain occurs, the ACL applies an excessive tensile force at its attachment. The incompletely ossified tibial spine offers less resistance than the ACL, and the tensile stress lead to an avulsion fracture of the tibial intercondylar eminence. Its treatment requires anatomic reduction to provide knee stability and a rigid fixation to minimize postoperative immobilization time.
***Materials and Methods*** We retrospectively reviewed 27 patients (15 males, 12 females) 10 to 14 years old who had intercondylar eminence tibial fracture from 2010 to 2017. In our series, the most common injury was fall from a bicycle (13 patients). Other patients injured while skiing (5 patients), skating (4 patients) playing football (3 patents) or volleyball (2 patients). All the fractures were itemized on Meyer and McKeever classification: conservative treatment (immobilization in long leg cast with extended knee) was performed type 2 and type 1 fractures (n=8). Surgical treatment, consisting in arthroscopically assisted reduction and fixation with bioabsorbable pins, was performed in type 3 fractures (19 patients, 8 males, 11 females). Postoperative care was made with immobilization at 10° for 21 days, and subsequent physiotherapy. Patients have been checked with x-rays, MRI and clinical examination.
***Results*** With a mean follow up of 3.3 years, surgically treated patients showed no difference of length or either axial or rotational deviations, nor loss of ROM, or instability: all patients returned to their pre-injury level of activity after 90 days.
***Conclusions*** Our technique showed to restore stability by reinserting spines in their anatomical position and by retensioning ACL; furthermore, the technique revealed to be safe and avoiding growth complications, fast and minimally invasive.

Knee

**EP-101**

**Prospectively calculated utility values in children with osteochondritis dissecans of the knee**

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**Level II**

***Introduction and Objective*** The purpose of this study was to identify the patient-perceived utility scores for health states associated with pediatric OCD lesions of the knee.
***Materials and Methods*** Children and adolescents being treated for OCD of the knee were prospectively interviewed. Six OCD-associated health states were described for the following clinical scenarios: 1) Symptomatic OCD lesion, 2) Non-operative rehabilitation, 3) Post-operative rehabilitation, 4) Intermediate treatment success, 5) Early degenerative knee changes, and 6) Successful treatment (asymptomatic). Patients were asked to assign health utilities to each state using a standardized feeling thermometer (0-100: 100=perfect health). Subgroup analysis investigated for any associations of utility scores with demographics, disease burden (unilateral vs. bilateral OCD), and patient reported outcome measure (PROM) scores.
***Results*** One hundred patients were included in the study, of which 74% were male. Median age was 13(range: 9-20) years. Calculated median utilities for included health states were as follows: symptomatic OCD lesion (15), non-operative

rehabilitation (30), post-operative rehabilitation (30), early degenerative changes (57.5), intermediate treatment success (65), and successful treatment (100). Patients with bilateral OCD lesions assigned significantly lower utility scores to being in an intermediate treatment success state (50 vs. 65, p=0.024) and developing early symptomatic degenerative change state (30 vs. 60, p=0.002). Age, sex, and PROM scores demonstrated no association with utility scores.
***Conclusions*** The current study indicates that OCD lesions are perceived to have a devastating impact on pediatric HRQoL, and provides utility values for use in cost-benefit analyses.

Knee

**EP-102**

**Anterior cruciate ligament reconstruction using semitendinosus graft in children**

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**Level II**

***Introduction and Objective*** Managing ACL injuries in skeletally immature patients remain a difficult. The main aim is to retrospectively compile normative data on the cross-sectional area of semitendinosus tendon and ACL gauge in children and young adults.
***Materials and Methods*** Knee MRI examinations from December 2012 to July 2014 were performed in 132 patients (83 female and 49 male patients). The mean age was 14,9 years old (8 - 18). Measurements of cross-sectional area (CSA) of semitendinosus (ST) tendon were performed on an axial view on the grey scale by the two independent researchers. ACL gauge were counted additionally.
***Results*** It was found that CSA of ST tendon is related to age and its growth is asymmetric. Analysis of the results leads to the conclusion that the highest growth dynamics of CSA for ST tendon at the level of femoral growth plate occurred at age 12, and at the level of tibial growth plate occurred at age 13. The growth of the ACL gauge is symmetrical until 18 years old.
***Conclusions*** After exceeding 13 years old CSA increments of ST tendon in skeletally immature patients are much smaller and the tendon become appropriate material for the graft.

Knee

**EP-103**

**Tape augmentation to protect graft in pediatric ACL reconstruction – review of literature and own results**

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**Level III**

***Introduction and Objective*** With the growth of sports activities of children and adolescents we see increasing numbers of total rupture of the anterior cruciate ligament which requires reconstruction. As shown by many data, a graft diameter of less than 7.5 mm can be important in case of secondary injury. The aim of the study is to evaluate the results of reconstruction of the anterior cruciate ligament in children and adolescents with the use of hamstring tendons during which the diameter of the obtained graft was less than 7.5 mm and were augmented with FiberTape.
***Materials and Methods*** In our Department, every year we perform 80-100 reconstructions of the anterior cruciate ligament in patients under 18 years of age. From 2015, in case of obtaining a graft below 7.5mm, we additionally reinforce it with Arthrex FiberTape. So far, we have made 36 such reconstructions.
***Results*** As shown in the literature, reconstruction of the anterior cruciate ligament using the graft diameter below 8mm can significantly increase the number of revision procedures. In our material from recent years, which includes over 400 reconstructions of the anterior cruciate ligament, we have about 11% of secondary graft damage (7-8% partial lesions and 3-4% total). In the examined group of patients, we had one case of complete graft rupture, which required revision reconstruction.
***Conclusions*** 1) Reconstruction of the anterior cruciate ligament with reinforcement with synthetic tape in the case of small graft diameter in patients under 18 years of age is characterized in most cases by very good and good clinical results. 2) Reconstruction of the anterior cruciate ligament with reinforcement with synthetic tape may affect the number of better results, however, further observations are needed, due to the short period of observation.