

5.1

SHALL UNSTABLE SUPRACONDYLAR FRACTURES OF THE HUMERUS BE FIXED WITH CROSSED PINS RATHER THAN THREE LATERAL PINS? A RETROSPECTIVE COHORT STUDY

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Introduction: This study aims at comparing outcome and complications of crossed pinning (CP) or lateral pinning (LP) using three Kirschner wires (K-wires) for unstable extension-type supracondylar fractures (SCF) in paediatric patients.

Methodology: A retrospective review of a Hong Kong regional hospital from January 2012 to June 2017 identified 28 consecutive patients. 15 patients were treated with LP, 13 patients with CP. Radiographic outcome (changes of Baumann angle compared with contralateral side) and complications (postoperative nerve palsy and loss of reduction requiring revision operation) were compared.

Results and Analysis: No statistically significant difference in radiographic outcome between two groups. No revision operation was performed. Iatrogenic ulnar nerve palsy was only found in CP group and number needed to harm was seven. There was an incidental finding of two cases of broken K-wire in the CP group.

Discussion and Conclusion: Both methods produced similar radiographic outcomes, but complications (ulnar nerve injury and broken K-wire) in CP was significant. The third pin should be inserted laterally. If a medial pin is used, removal of one lateral pin before insertion of medial pin.

5.2

QUANTITATIVE ANALYSIS OF A 'LAST DITCH' CONTROLLED FRAME DESTABILIZATION BY A NOVEL 'SPACER SLEEVE' DEVICE IN LIMB LENGTHENING PATIENTS: A PILOT STUDY

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Introduction: Consolidation phase of distraction osteogenesis is often halted by plateaus in bone mineralisation, prolonging not only the treatment duration but also fixator-related complications. Serial pin removal is a ready solution but its effects are not yet quantified. We designed a 'spacer sleeve' device that mimics the familiar Controlled Frame destabilization technique of serial pin removal in patients using LRS-Orthofix but remains a pain-free, reversible outpatient procedure. This study aims to quantify the effect of this spacer sleeve on regenerate consolidation using serial Dual-energy X-ray absorptiometry (DXA) measurements.

Methodology: Limb-lengthening patients showing late stasis were retrospectively evaluated for Spacer sleeve usage, patient- procedure details, Bone Mineral Concentration (BMC)% changes including its rate after spacer application.

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

Discussion and Conclusion: 'Spacer sleeve' device which stimulates serial pin removal illustrated a significant quantifiable improvement in the Bone mineralisation in the regenerate. A Larger prospective study is planned to further validate its application.

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5.3

GONADAL SHIELD: IS IT THE ALBATROSS HANGING AROUND THE NECK OF DDH RESEARCH?

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Introduction: Prospective RCTs and long-term studies are essential future directions for building evidence-based practice in DDH however sufficient attrition in data (>20%) can introduce bias deteriorating research quality. And while Pelvic radiography is synonymous with DDH assessment and Gonadal Shield (GS) recommendations with Pelvic radiography, loss to diagnostic information and inadequate protection have been increasingly implicated to GS usage with significantly worse implications in females. Understandably for DDH, a disease with 80 % female prevalence, the impact of GS usage on quality of radiographs may be worse. This study aims to objectively define implications of GS recommendations in DDH patients.

Methodology: Pelvis X-rays of all DDH patients diagnosed in a year at a tertiary level Paediatric orthopaedic centre with a written protocol for GS usage were evaluated. Images were reviewed for gender, GS presence, adequate gonadal protection and obstruction of essential anatomical landmarks.

Results and Analysis: 131 Pelvis X-rays with DDH diagnoses (Age:1.25-6 years;107 female,24 male Pelvises) were reviewed. Only 42.67% (56) Pelvis radiographs used GS despite the presence of a clear protocol. GS was ineffective at gonadal protection in 73.2% (41) of the pelvises with worse protection in females (78.7% vs 44.4%; p=0.03). Useful anatomical landmarks were obstructed in 58.9% of all the X-rays identified with GS application. Lost diagnostic information was commoner in females than males (68.1% vs 11.1%, p< 0.01). Ironically, essential anatomy was obstructed in all the adequately protected female pelvises.

Discussion and Conclusion: Routine GS usage may result in substantial attrition of radiographic data in DDH patients.

5.4

PHYSEAL ARREST AFTER RADIAL NECK FRACTURE IN CHILDREN – A BENIGN PHENOMENON

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Introduction: Radial neck fractures occur in 2.9% of all pediatric fractures in Hong Kong. A well-known sequel is premature physal closure which occurs in around 76% of patients. Other potential complications include increased carrying angle and persistent functional deficit with loss of supination and pronation.

Methodology: Using our database we identified patients who sustained a radial neck fracture with premature physal closure aged between newborn till 17 and presented to our department between 1st January 2013 till 31st December 2014. Patients with fused physis upon injury and those who were lost to follow up were excluded. Upon follow up we will assess their ulnar variance, humeral-ulnar angle on anteroposterior x-ray and whether there is any functional deficit.

Results and Analysis: There were 4 patients who fit our criteria. They were all treated with K-wire fixation with one requiring open reduction. Mean age at presentation was 5 years 7 month (5 year 1 month to 7 year 5 month old); mean follow up was 51.5 months. Follow-up x-ray all showed radial neck physal arrest. Mean ulnar variance of injured arm was -1.29mm, mean ulnar variance of non-injured arm was -0.73mm. Standard deviation of difference in ulnar variance between injured and non-injured was 0.67. Mean humeral-ulnar angle of injured arm was 14.9° valgus, mean humeral-ulnar angle of non-injured arm was 12.1° valgus. Standard deviation of difference in humeral-ulnar angle between injured and non-injured was 3.8. None reported functional deficit.

Discussion and Conclusion: Physal arrest of radial neck does not confer significant deformity or functional deficit.

5.5

SEXUAL DIMORPHISM IN BONE MICROSTRUCTURE APPEARS DURING PUBERTY IN HONG KONG ADOLESCENTS

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5.6

20 YEARS EPIDEMIOLOGY OF FRACTURE NECK OF FEMUR (FNOF) IN PAEDIATRIC POPULATION IN HONG KONG

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Introduction: Fracture neck of femur (FNOF) is a rare injury in pediatric population but associated with significant complications. The aim of the study is to study the epidemiology of FNOF in pediatric population in HK, and to find out any specific pattern and preventive measures to reduce this injury.

Methodology: A retrospective cohort study of 72 patients age under 18 suffered from FNOF from 1998-2017 was carried out. Patient demographics, injury mechanism, date of admission, fracture pattern, functional and radiological outcome were reviewed and analyzed.

Results and Analysis: Mean age at injury was 12.42, of which 8 of them (11.1%) were under 10 years old. 68.1% were male. 77.8% fractured left NOF. 46 (59.9%) cases were admitted during summer (May-Nov). Data was split and analyzed separately due a major change in surgical procedure in year 2008. In 1998-2008, 21 (60%) patients sustained low energy injury (fell from ground) while 14 (40%) had high energy trauma (fall from height, Road Traffic Accident) ($p < 0.01$). In 2008-2017, 24 (82.8%) patients sustained low energy injury while 5 (17.2%) sustained high energy trauma ($p < 0.01$).

Discussion and Conclusion: Majority of patients sustained FNOF are older children (>10 years old) and most were boys. There is seasonal pattern for the injury where summer time is slightly predominant. There is a changing dominance in injury mechanism from majority of high to low energy trauma over the 20 years. Factors influencing the increasing rate of low energy trauma have yet to be explored.

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5.7

SCOLIOSIS IN OSTEOPENIA IMPERFECTA: A SINGLE CENTRE CROSS-SECTIONAL STUDY

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Introduction: Scoliosis has been frequently reported in patients with osteogenesis imperfecta (OI). We aim to show the differing prevalence, characteristics, and clinical implications of scoliosis among the types of OI in our ethnically Chinese cohort.

Methodology: Patients with OI and at least 1 spine radiograph were enrolled and classified into Sillence types I, III, IV and V based upon clinical and radiological features. Cobb angle was measured with severity and characteristics of curve noted according to the SRS glossary.

Results and Analysis: 127 patients (75 male, 52 female, mean age 9.6 years) were included. Overall prevalence of scoliosis among patients was 53%. Type III OI had the highest prevalence (76%) compared to types V (60%), IV (44%), while type I had the lowest (29%). Type III also had the highest prevalence of severe scoliosis (38%). Severity of scoliosis was positively correlated with age in all OI types (type III $p < 0.001$, IV $p < 0.001$, V $p = 0.004$ respectively), apart from type I ($p = 0.222$). 58% of all scoliotic curves were located in the thoracic region (T2-T11). 63% of primary curves were right sided.

Discussion and Conclusion: Type III OI demonstrated the highest prevalence of scoliosis, both overall and severe. Given that scoliosis occurs mostly in the thoracic region (affecting cardiopulmonary function) and is correlated with age, early and aggressive intervention is appropriate. Type I has a relatively lower prevalence and no correlation with age, thus may be treated more conservatively.

5.8

THE EFFICACY OF HALO TRACTION FOR SCOLIOSIS IN OSTEOPENIA IMPERFECTA - THE OPTIMAL DURATION OF TRACTION

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Introduction: Halo traction had been described in treating scoliosis in Osteogenesis Imperfecta (OI) patients. However, little is known for the optimal halo traction protocol. This study aimed to investigate the optimal duration of halo traction for scoliosis in OI patients.

Methodology: A review was performed on 6 consecutive patients who have undergone halo traction before posterior release and spinal fusion. Cobb angles of the major coronal curves were measured. The amount of correction achieved by the first month, second month and beyond 2 months of traction were analyzed. Patient outcomes were also reviewed.

Results and Analysis: In this cohort of 6 patients with an average pre-traction Cobb angle 116.3°, the amount of correction achieved by halo traction was 23.7% (28.7°) ($P = 0.007$). The percentage of correction achieved at the first month was 63.2% ($P = 0.026$). Further improvement achieved in the second month was of an average of 10.5%. None of the patients developed neurological complications during the traction.

Discussion and Conclusion: Preoperative halo traction for scoliotic OI patients is effective and safe. Significant radiographic curve correction occurred by the first month of traction. Traction beyond 1 month should only be considered if the perceived benefit outweighs the risk of prolonged traction.

5.9

PAEDIATRIC ICE-SKATING INJURIES IN HONG KONG

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5.10

THE POSITION OF THE NON-TELESCOPIC INTRAMEDULLARY NAIL INFLUENCES THE OUTCOME OF THE TIBIAL DEFORMITY CORRECTION IN SKELETALLY IMMATURE PATIENTS WITH OSTEOGENESIS IMPERFECTA

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Introduction: Tibial deformities are common in patients with osteogenesis Imperfecta (OI). Non-telescopic intramedullary nails are used for long bone deformity correction where telescopic nails are unavailable. However, as the child grows up, the nail will become too short and the nail may subsequently cut out anteriorly. We would like to evaluate the risk factors of cutout of tibial nails in skeletally immature OI patients undergoing tibial deformity correction.

Methodology: In this retrospective study, 16 skeletally immature OI patients (24 tibia) had undergone tibial deformity correction between 2015 and 2016. They had a minimum of 4 years of growth remaining. The minimum follow-up was 18 months. The lateral x-rays of the tibia were used for assessment. The pre-op, immediate post-op and the latest follow-up xrays were compared. Factors including (1) the distal position of the nail immediate post-op and (2) pre-operative anterior tibial bowing were reviewed. The distal position of the nail was determined by the a/b ratio.

Results and Analysis: The average age of the patients was 7.04 years old with an average follow-up of 32 (18-41) months. 9/24 tibia had nail cutout and 15/24 without cutout. Cutouts were noticed on average at 15.8 months post-op. Comparing the two groups, the a/b ratio was significantly smaller in cutout group (0.404) i.e. more anteriorly placed; The anterior bowing was larger in the cutout group (62 degrees) vs non-cutout (31.9 degrees), but not reaching statistically significant level.

Discussion and Conclusion: Anteriorly placed tibial nail distally is shown to be at risk of early cutout. Larger tibial bowing may require more osteotomies to restore the alignment allowing the nail to be more centrally placed distally.

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5.11

COMPARISON OF HEALING BETWEEN PATIENTS WITH OSTEOGENESIS IMPERFECTA CAUSED BY WNT1 AND COL1A1 MUTATION UNDERGOING MODIFIED SOFIELD MILLAR OPERATION

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Introduction: Osteogenesis imperfecta (OI) is a group of genetic disorders that lead to bone fragility and deformities. The objective of this study is to compare bone healing time after long bone corrective osteotomies in patients with WNT1 and Col1A1 mutation.

Methodology: Sixteen skeletally immature OI patients, WNT1 (7/16) and Col1A1 (9/16) mutations were recruited. All had undergone femoral or tibial osteotomies with internal fixation between 2014 and 2018 in HKU Shenzhen Hospital. A total of 21 femoral and 14 tibial osteotomies were analysed. The healing time of these osteotomies was compared with non-OI osteotomies. For femoral osteotomies, there were 9 in WNT1, 12 in Col1A1 and 6 in control groups. For tibial osteotomies, there were 7 in WNT1, 7 in Col1A1 and 5 in control groups. Bone healing was assessed by postoperative x-ray and radiographic union was determined by two senior pediatric orthopaedic surgeons.

Results and Analysis: In femoral osteotomy, the duration of bone union was significantly longer in WNT1 (61.56 days) than the other two groups Col1A1 (47.33 days) and control group (41.67 days) with $p < 0.05$. For tibial analysis, there was also a trend of longer healing time in the Wnt1 group, however, not reaching statistically significant level.

Discussion and Conclusion: WNT1 is important in bone development and fracture healing. Wnt1 mutation showed negative influence to the bone healing after osteotomy. Better understanding of the genetic mutation helps to improve the management in this heterogeneous disease.

5.12

DISTINCT PATTERNS OF JOINT DYSFUNCTION IN PATIENTS WITH TYPE V OSTEOGENESIS IMPERFECTA

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Introduction: In 2000, Glorieux et al. described a novel type of osteogenesis imperfecta (OI). Albeit resemblance with type IV in terms of severity, distinguishing radiological features including post-fracture hyperplastic callus (HPC), calcification of interosseous membrane (CIM) and radial head dislocation (RHD) were present. This clinical presentation was therefore termed type V OI.

Methodology: Patients admitted for inpatient care at The Hong Kong University-Shenzhen Hospital and Duchess of Kent Children Hospital between January 2006 and May 2018 with a diagnosis of type V OI (either diagnosed clinically or genetically with the IFITM5 c.-14C>T mutation) were recruited, with a total of 19 patients.

Results and Analysis: A remarkable finding is spontaneous autofusion of the hip in type V patients (22.22%). 62.50% had scoliosis, average Cobb angle was 60.45 (range:14-140). Prevalence of other radiological features were comparable to that reported in previous literatures (HPC: 73.68%, CIM: 82.35%, RHD:100%). HPCs were located at femur (86.35%), tibia (9.09%) and humerus (4.55%). With peri-operative use of indomethacin, 25.00% patients develop HPC postoperatively. Comparatively, 60.00% patients who did not receive indomethacin developed HPC.

Discussion and Conclusion: This is the first paper presenting the hip dysfunction resulting from heterotopic ossification in OI type V patients. Early surgical intervention for scoliosis is suggested due to potential progression to cardiopulmonary-compromised state. Low incidence of HPCs with perioperative use of indomethacin is observed. The effectiveness of indomethacin in prevention of HPCs formation is yet to be confirmed with controlled study. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

5.13

LONG-TERM OUTCOME STUDY OF HIP INSTABILITY IN CEREBRAL IN CEREBRAL PALSY – WHAT CAUSES FAILURE AND HOW CAN WE PREVENT IT?

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Introduction: Cerebral palsy patients are at risk of hip instability, to which various soft tissue and bony surgeries are performed should conservative management fail. There are few sizeable studies to evaluate middle-to-long term outcomes and reoperation rates.

Methodology: Cerebral palsy patients at Duchess of Kent Children's Hospital with hip operations performed for subluxation in 1998-2012 with minimum 5 years follow-up were reviewed. Failure was defined as repeat operation to the same hip due to recurrent subluxation. Age, Gross Motor Function Classification System level, tone abnormality, operation type, Reimer's migration index (RMI), acetabular index (AI), neck shaft angle (NSA), pelvic obliquity, and scoliosis severity were assessed.

Results and Analysis: 95 hips from 60 patients with mean follow up of 10.2 years were included. 6 hips (6.3%) failed at our centre and received a reoperation. In soft tissue only procedures, RMI>44% preoperative and >32% postoperative, NSA>159° were associated with failure. For isolated femoral osteotomies, age <8.5 years and postoperative RMI>28% were associated with failure. Among pelvic osteotomies, postoperative RMI>32% and AI>30° were associated with failure. Other factors analysed were not associated with reoperation.

Discussion and Conclusion: Degree of hip subluxation, postoperative acetabular index, and pre-existing coxa valga are associated with need for remedial surgery. We should aim to correct RMI to <32% for soft tissue procedures alone. Bony surgery should be considered when preoperative RMI>44% or NSA>159°. If isolated femoral osteotomies are to be performed for patients >8.5 years of age, the RMI should be reduced to <28% post-op. Pelvic osteotomies should target postoperative RMI <32% and AI <30°.

USING ULTRASOUND FOR QUANTITATIVE ASSESSMENT OF SCOLIOSIS TO REDUCE RADIATION EXPOSURE: A DETAILED ANALYSIS OF 952 PATIENTS USING EOS RADIOGRAPHY AS GOLD STANDARD

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Introduction: Repeated radiography poses health concerns for adolescent idiopathic scoliosis (AIS) subjects. Although radiation-free ultrasound was developed for measuring spinal curvatures with promising results reported, its accuracy with respect to curve severity, curve apical levels, genders, BMI, ages and heights remains undefined.

Methodology: This prospective diagnostic accuracy study involved 952 AIS patients (75.7% female, mean age 16.7 ± 3.0). Coronal Cobb angles (E_Cobb) were measured on standing posteroanterior EOS radiographs. Predicted_Cobb for predicting E_Cobb was calculated from Spinous Process Angle (SPA) obtained with automatic algorithm on volume projection images from ultrasound scanning of the spine. Intra-class correlation, linear regression, cross-tabulation, and Bland-Altman plot were used for analysis.

Results and Analysis: Inter-rater reliability was 0.949 for E_Cobb and 0.838 for SPA measurement respectively. 1625 structural curves were identified (E_Cobb $28.7 \pm 11.6^\circ$). Among 1432 curves (88.1%) detected by ultrasound, E_Cobb and SPA were significantly correlated ($r=0.816$, $p<0.001$). Correlation was stronger for upper spinal curves (USC, $r=0.873$, apices T7 to T12.5) and lower spinal curves (LSC, $r=0.740$, apices L1 or below) than upper thoracic curves (UTC, $r=0.629$, apices T6.5 or above) (all $p<0.001$). Taller stature was associated with stronger correlation. For E_Cobb $<30^\circ$, 66.6% USC and 62.4% LSC had absolute differences between E_Cobb and Predicted_Cobb $\leq 5^\circ$. Predicted_Cobb underestimated E_Cobb by $>5^\circ$ in 6.0% USC and 7.2% LSC. Among 190 ultrasound false-negative curves (11.7%), 187 (96.9%) were UTC or with end-vertebra tilt angle $<10^\circ$.

Discussion and Conclusion: Ultrasound could be a viable option in lieu of conventional radiography for measuring coronal curves with apices at T7 or lower and Cobb angle $<30^\circ$.

INNOVATIVE HANDHELD DEVICE FOR POPULATION SCREENING AND EARLY DETECTION OF SCOLIOSIS

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Introduction: Scoliosis is a 3-dimensional spinal deformity. Traditionally, screening is performed using the scoliometer to measure the back asymmetry of the subjects in forward bend position. However, the location of the hump is inaccurate, and sensitivity and specificity is low with intra and inter-observer errors. The authors developed a novel handheld device that utilizes a gyroscope to assess back asymmetry in real-time 3D. It can also provide more precise identification of the site of deformity and its severity. The objective of this study is to validate its utility in assessing back asymmetry and compare it to the scoliometer.

Methodology: Scoliosis patients between 8-20 years old were consecutively recruited. The patients were assessed by scoliometer, our handheld device and X-rays. The measurements of apical trunk rotation (ATR) by scoliometer and the tilt angle (SSA) by our device were performed with patients in forward bend position. Intra- and inter-observer reliabilities were assessed by Cronbach's alpha. Correlation of ATR and SSA parameters at their equivalent sites was performed.

Results and Analysis: A total of 577 patients were recruited for the study. The intra-observer reliability was determined to be 0.9 for the SSA. The inter-observer reliability for the spine length, SSA for the maximum +/- tilt, SSA for upper thoracic and lower thoracic were 0.84, 0.67, 0.87, 0.7 and 0.82, respectively. When comparing the correlation between ATR and SSA, there was a significant correlation between Cobb angle measurement of the thoracic ($r=0.77$) and lumbar ($r=0.66$) curvatures.

Discussion and Conclusion: This is the first validation study demonstrating that our novel handheld device has high intra- and inter-observer reliabilities when assessing the spinal profile of patients in forward bend position. Our device provides equal utility as the scoliometer in evaluating back asymmetry with the advantages of real-time feedback and 3D assessment.