

**Dorsal cortical comminution as a predictor of re-displacement of distal radius fractures in children**

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**Background:** Distal radius is the most common site of fracture in the paediatric population and most of these can be managed with closed manipulation and plaster application. The factors which have been associated with re-displacement of these fractures are the degree of initial displacement, quality of reduction, and a high cast index ( $>0.7$ ). We conducted a retrospective audit of distal radius fractures managed at the Sheffield children hospital to look at our rate of re-displacement and the factors causing it.

**Patients and methods:** The study period was from February to November 2008. Case records and sequential radiographs of children who underwent manipulations  $\pm$  K-wiring for distal radius fractures were reviewed. Open fractures, Salter Harris III/IV fractures, repeat fractures in previously healed fractures, pathological fractures and fractures after physeal closure were excluded from the study. The criteria used to define re-displacement were (1) Any angulation in the AP radiograph or (2)  $>10^\circ$  angulation in the lateral radiograph or (3)  $<50\%$  apposition on either the AP/Lateral radiograph.

**Results:** 129 patients (134 fractures) met the criteria. 10 fractures were excluded from analysis due to unknown outcome leaving 120 patients (124 fractures) for analysis. There were 93 boys and 27 girls with a mean age of 10.6 years (range: 2–16 years). The rate of re-displacement was 24% (30/124). Chi-Squared test showed that there was a higher risk of re-displacement with fractures that were completely displaced ( $P=0.02$ ); dorsal bayonet fractures ( $P=0.007$ ), fractures with comminution ( $P=0.001$ ) and those where the quality of initial reduction was not acceptable ( $P=0.002$ ). Forward stepwise logistic regression analysis revealed comminution at the fracture site to be the most significant factor associated with re-displacement increasing the odds of re-displacement by 5.82 (95% CI: 2.08–16.22,  $P=0.001$ ). There seemed to be trend towards a reduced risk of re-displacement when K-wiring was done in the presence of comminution ( $P=0.12$ ).

**Conclusion:** The presence of dorsal cortical comminution at the fracture site on initial radiographs should alert the treating surgeon to a significantly higher risk of re-displacement and supplemental k-wiring should be considered in this situation.

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**2B.13****Paediatric forearm fractures—are we doing justice in treating them?**

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**Background:** Forearm fractures represent approximately 20–30% of all fractures in children. Maintaining acceptable reduction is not always possible, and re-displacement or re-angulation are the most commonly reported complications and various factors can influence a satisfactory outcome. The quality of casting has a major influence on the outcome of conservative management and this can be assessed using the Cast index and the Gap index.

**Aim:**

- To look at the remanipulation rate in a University Hospital.

- To define the importance of various factors affecting redisplacement or reangulation in paediatric forearm fractures.

**Methods:** We looked at 114 forearm fractures treated with manipulation under anaesthesia and plaster over the period of 18 months within a mean follow up of 6 weeks. The mean age group was 9.6 years (1 month–16 years).

The gap index and cast index were calculated independently on radiographic assessment by two registrars and a mean of both the results was taken.

Various other factors and their significance in the outcome is calculated.

**Results:** The number of fractures remanipulated was 20/114 (17.4%). The rates for consultants was 18.2%, Registrars: 12.9%, career grade surgeons: 29.2% and SHOs 16.7%.

The average cast index in our study was 0.81 for consultants, 0.79 for registrars and 0.8 for the career grade surgeons and 0.83 for SHOs.

The average gap index was  $>0.2$  across all grades of surgeons with only 21% achieving less than this.

The inter-observer variability between the registrars taking the readings was not significant.

Initial displacement of the fracture and non-anatomical reduction had significant bearing on the rate of remanipulation.

**Discussion:** Various studies have shown re-manipulation rate of 7–14% in forearm fractures. Our results show that there is an overall increased rate of re-manipulation (17.4%) at our centre.

The Cast index is a radiological measure of plaster moulding and a value of  $>0.8$  is associated with the significant risk of re-displacement. The Gap index is the measure of space between the plaster and the skin and values above 0.15 indicates poor moulding and excessive padding. Gap index will increase when the swelling subsides after manipulation. As measurements were taken on check radiographs 1 week post-reduction this could affect the results for gap index but not for the cast index.

**Conclusion:** High remanipulation rates in forearm fractures in children will need to be addressed. Improving plastering techniques will improve the overall rates of re-displacement and need for re-manipulation. All registrars and junior staff should be trained adequately in plastering and moulding techniques and to assess the outcome using these parameters. Displaced fractures should be reduced anatomically and should be fixed internally where unstable. It is important to look for the gap and cast index of plaster in the follow up clinics before reinforcing plasters.

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**2B.14****Trampoline trauma**

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**Introduction:** During 2002 in the UK, 4200 children were recorded to have been injured on a trampoline. There has been a 50% increase in people going to hospital after an accident with a trampoline since then. The aim of this study was to establish the severity of injuries sustained by children on outdoor play equipment and whether trampolines were contributing to a large proportion of the more severe injuries.

**Methods:** We reviewed the injuries sustained on static outdoor play equipment amongst all our paediatric admissions to Princess Royal Hospital, Telford, from September 2007 to September 2008.

We gave each patient a severity score from 1 to 3 depending upon the nature of the injury. The score was given by two independent orthopaedic consultants. Scoring took account of the need for surgical intervention and any associated neurovascular injury.

**Results:** There were 47 patients. Trampoline injuries accounted for 41% and climbing frames 34% of the injuries requiring hospital admission. The trampoline injuries had an average trauma severity score of 2 which was higher than all the other play equipment. Trampoline injuries remained in hospital for on average 1.6 days and 74% of these patients required a general anaesthetic to allow treatment of the injury. The most common injury was fracture of a forearm bone, 38%.

**Discussion:** The study showed that a child admitted to hospital with a trampoline related injury is likely to require orthopaedic care (79%), require a general anaesthetic (74%) and will on average be in hospital more than 24 h. Trampoline injuries were the most severe injuries. Trampolines are not a new device, but have only recently been readily accessible and affordable to the general public, where they can be erected in the garden and are not subject statutory safety measures. The authors propose that the leisure safety information leaflet on trampoline safety issued by The Royal Society for the Prevention of Accidents be included with the purchase of all home trampoline kits in the UK.

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## 2B.15

### Management of displaced radius and ulna shaft fractures in children—should we be afraid of surgical intervention?

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**Background:** Displaced fractures of shaft of radius and ulna are frequent in pediatric population. Those fractures are occasionally difficult to reduce and to treat with close methods. They are often challenging for a surgeon who has to decide if internal fixation would be appropriate in view of its risks. In our study we wanted to establish the complication rate of surgical management of such fractures. We compare the outcome of surgical and conservative management of fractures of radius and ulna.

**Methods:** We reviewed retrospectively X-rays and clinical notes of all children who had intervention (MUA or fixation) to shaft of radius or ulna fracture in 2008 in our hospital. We identified patients using surgical database. We compared the radiological and clinical outcome and complications associated with the treatment.

**Results:** We identified 56 children who had procedure on displaced fracture of ulna and radius shaft fracture. The age varied from 23 months to 15 years, mean age 9.45 years. The injury was most common a result of fall (40%), bicycle accident (22%), sport related (18%), trampoline injury (14%). Angulation of forearm bones ranged from 30° to 95°. There were 2 open injuries. 26 fractures (46.5%) were treated with internal fixation as a definitive measure; remaining 30 fractures were manipulated under anaesthesia and treated in above elbow cast. In internal fixation group there were 5 patients who had previous manipulation and suffered fracture re-displacement and required surgical intervention.

In conservative group time to union was from 4 to 6 weeks (mean 5.8 weeks), in surgical group time to union was within range from 4 to 12 weeks (mean 6.6 weeks). This difference was not statistically significant.

Out of 36 fractures that were attempted to treat conservatively, 6 (16%) re-displaced and required internal fixation. 4 other patients required repeated manipulations to achieve adequate reduction

of fracture. 27% of patients who had MUA required further intervention. Patient treated conservatively did well, and achieved satisfactory functional outcome. 4 of those patients (13%) healed their fracture with significant angulation (more than 20 degree), 1 patient had fracture that healed in 30 degree of dorsal angulation, but the functional outcome was satisfactory, and the fracture continues to remodel.

In the group of patients who had internal fixation 18 patients (70%) had flexible nailing. 6 patient had a single nail (2 to radius and 4 to ulna), others had both bones nailed. Rest of patients had plating to their fractures. All flexible nails were removed after fracture achieved full union. The time from surgery to metal removal varied from 8 to 16 weeks (mean 13 weeks). Only 2 out of 8 patients had their plates removed, other patients were asymptomatic and did not require removal of metal.

There was 1 post-operative infection following flexible nailing, but that settled down with oral antibiotics only and patient did not require admission to hospital. Out of 4 patients who had single nail to their ulna, 3 patients (75%) suffered significant (>20 degree) angulation to their radius. All of patients had satisfactory initial reduction, but fracture re-displaced with time. One fracture was angulated to 40° and required further intervention in specialist centre. None of fractures treated with both bones nail re-displaced. There were no growth problems following internal fixation.

**Discussion:** We believe that internal fixation of forearm bones in pediatric population is safe and acceptable method of treatment displaced fractures. The complications are rare and could be related to inadequate fixation. Authors recommend fixation of both bones rather than one when attempted surgical intervention, as there is significant chance of fracture re-displacement. We think intramedullary flexible nailing technique should be familiar to most of orthopaedic surgeons as it is very useful and reliable method of managing pediatric displaced fractures.

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## 2B.16

### Clinical outcome following internal fixation for displaced lateral humeral condyle fractures in children

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**Purpose:** Lateral humeral condyle fracture is the second commonest fracture of the elbow in children. Surgical treatment aims to restore the normal anatomy around the growth plate and the articular surface. Current literature shows various techniques for internal fixation. The purpose of our study is to determine the clinical outcome following various fixation techniques.

**Methods:** Over a 4-year period, 35 patients underwent surgical fixation for displaced lateral humeral condyle fracture in our centre. Case notes and radiographs were reviewed and their demographic data, the mechanism of injury, timing of surgery, methods of surgical fixation, fracture union and post-operative complication were noted. We used the Milch and Badelon classification to classify the fractures.

**Results:** There were 24 males and 11 females. Mean age at injury was 6.0 years. Pre-op radiographs confirmed 6 Milch type 1 fractures and 29 type 2 fractures. Fall on an outstretched hand was the common mechanism. Badelon classification showed 13 type 3 fractures and 22 type 4 fractures. The average time to surgery following injury was 4 days. Two or three Kirschner wire fixation was used in majority of cases except for four patients in who screw or a combination of Kirschner wire and screw fixation was used. Four