

# Title – Editorial: Pediatric scaphoid fractures – a problem we need to take more seriously?

Generally scaphoid fractures in children have been relatively under researched compared to those in adults. This applies not only to the epidemiology but also to the investigation, management and clinical outcomes. Firstly, it is worth noting that the definition of 'pediatric' or 'children' is used variably and may refer to either those aged under age 18 or under 16. The epidemiological evidence shows that scaphoid fractures are extremely rare in children under age 9 but become increasingly more common with increasing age up to the peak incidence in young adulthood (1,2). With the increasing use of early MRI for children with normal initial X-rays and positive scaphoid signs it has been shown that scaphoid fractures are also highly prevalent in this group of 'suspected scaphoid fractures' (3–5).

In this context, the study by Patel et al set out to identify clinical and radiographic findings of pediatric scaphoid fractures that predicted the need for surgical treatment(6). They reviewed a series of pediatric patients ( $\leq 18$  years) with scaphoid fractures, who underwent radiographic examination and treatment at their tertiary care pediatric hospital over a six-year period and identified all surgically treated patients. From the remaining conservatively treated patients, age matched comparisons were randomly selected. After randomisation and blinded to outcome, skeletal age, fracture characteristics (location, displacement, comminution, articular involvement, perfracture radiodensity, lobulated perfracture resorption, fracture gap), and presence or absence of osteonecrosis were recorded. Findings were compared between surgically treated and conservatively treated groups to identify the predictors of surgery.

In total there were ninety-six children (81 males, 15 females, mean age: 15.0) which included 48 in the surgery and 48 in the non-surgery groups. Proximal pole fractures, perfracture radiodensity and the presence of osteonecrosis were uncommon, but were only found among patients in the surgery group. The important findings were that proximal pole fractures (OR=6.67, 95% CI: 1.48–16.78,  $p=0.04$ ), fracture displacement (OR=6.30, 95% CI: 1.32–33.87,  $p < 0.01$ ), and longer delay to initial radiographs (OR=1.08, 95% CI: 1.04–1.18,  $p=0.01$ ) were independent predictors of surgery. Notably there was a more mature skeletal age among children in the surgically than non-surgically treated groups despite matched chronological age between the groups.

Fracture displacement has been shown to be a predictor of fracture union in adults(7-9). This finding being replicated is perhaps unexpected but still a useful one. Clearly the greater the displacement and the more skeletally mature the child, the higher the risk of non-union and one should consequently reduce the threshold for acute surgery. A delayed presentation of greater than 3 weeks has been shown to be associated with scaphoid non-union in children(4). The statistically significant finding ( $p < 0.01$ ) of a far higher median time from injury to orthopaedic presentation in the surgery group (45.5 days) versus the non-surgery group (4.5 days) reinforces this important message. There can be no doubt that prompt cast immobilisation reduces the risk of non-union in children and this should have clear implications for paediatric care pathways. Although children have a high union rate a large systematic review of outcomes has shown that cast treatment has a non-union rate of around 4%(10), and again this is consistent with this study's findings of a delayed or non-union rate of 4.2% in the non-surgery group. One should note that these studies are not prospective and randomised, meaning that surgeons are likely selecting out the higher risk patients for acute surgery, meaning that this 4% figure likely applies to the lower risk groups.

So, putting this all together what does this mean for optimising our clinical pathways for children? Well, first we would advise treating skeletally mature patients in a similar fashion to young adults. In this group there is no doubt that optimal management includes early MRI for all 'suspected scaphoid fractures' and a low threshold for early surgery for those at high risk of non-union(11). Early MRI results in a better patient experience, significant cost savings and enables prompt treatment(11). Although rare, early MRI will detect the occasional very proximal fracture which will benefit from early fixation. We would advise assessing displacement acutely with CT and being aware that the risk of non-union is considerably higher when displacement is greater than 1mm(9). In the skeletally mature when cast immobilisation is used there is a strong argument for careful radiological assessment at around the 6-week mark post injury and considering CT in cases of uncertain healing.

This then moves on to considering the optimal pathways of care for the skeletally immature, which as Patel et al describes is at around age 13 in girls and 15 in boys. Currently there is likely to be a wide variation in practice around the globe. It has been well described that early MRI pathways yield excellent patient and parental satisfaction, alongside excellent clinical outcomes(12). Early MRI significantly alters management(5). However, there remains an opinion that children can be safely treated with 'early mobilisation'(13). Notably in this recent 'early mobilisation' feasibility study by Cheung et al all patients were immobilised until their inclusion at 'over 10 days post injury' with normal x-rays for a baseline assessment, and the data regarding the exact time point of inclusion is not detailed

within the study. Irrespective of this study flaw, we would still argue that there are multiple reasons why 'early mobilisation' without an early diagnosis is not a pathway to aim for. The recent study by Patel et al details one key element of this argument, it is well established that a proportion of pediatric scaphoid fractures progress to non-union, this represents a significant potential harm for patients and a considerable cost to the health service. There can be no doubt that early diagnosis enables timely cast immobilisation and expedient surgery for the occasional very high-risk fracture (very proximal fractures in the older child). Early MRI-based diagnosis also benefits patients and parents as it facilitates safe early mobilisation of children without a scaphoid fracture, furthermore early MRI for suspected fractures is highly cost effective by reducing the clinic footprint(11,14). Notably the pathway proposed by Cheung et al is likely cost ineffective compared to early MRI, as all included patients were reviewed in clinic twice before the 'early mobilisation' protocol had begun (13).

Nonetheless it should be acknowledged that uncertainties remain for this heterogenous pediatric population due to its heterogeneity. Anecdotally we have an MRI cut-off of not using early MRI in our institution for those aged under 12 and this is somewhat arbitrary due to the lack of clear evidence. For those under 12 with clinical signs we treat with early cast immobilisation for around 2 weeks and then radiological follow-up if symptoms persist. For those from ages 12 to 15 we investigate with early MRI, and cast immobilise the scaphoid fractures for between 2 and 4 weeks depending on their age, skeletal maturity and location of the scaphoid fracture. Anecdotally, very occasionally a pediatric scaphoid non-union in the 'suspected' group occurs despite early detection of the fracture and prompt immobilisation. Certainly, one can assume that the non-union rate will be significant higher if one does not immobilise the scaphoid fractures, particularly in those approaching skeletal maturity.

In conclusion, the study by Patel et al adds significantly to our understanding of pediatric scaphoid fractures and reinforces that they are not necessarily benign in terms of outcome(6). Although there are clear uncertainties in the optimal management of suspected scaphoid fractures in the skeletally immature, we would argue that we should aspire for cost-effective excellence in our pathways, and this means striving for an early MRI-based diagnosis. The patient and their parents should be at the centre of our care, and one can only safely implement true early mobilisation with a clear diagnosis which would also enable us to promptly immobilise the true fractures to minimise the highly negative impact of non-union.

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