

## Paediatric base of proximal phalanx in children and remodelling of malunion

### X-ref

■ The so-called 'extra-octave' injury to the base of the proximal phalanx of the little finger is one of the more common paediatric phalangeal fractures. Usually, the little finger is caught awkwardly by the child and a physeal injury – either a Salter–Harris type 2 fracture or juxta-epiphyseal pattern – occurs. This leads to ulnarwards deviation of the digit, which results in an increased handspan, hence the name of the injury. This author from **Riyadh (Saudi Arabia)** has previously published on these injuries and has described the diaphyseal axis-metacarpal head angle (DHA), which can be used to quantify the degree of displacement.<sup>1</sup> In short, a line drawn through the centre of the phalangeal head and the centre of the metaphysis of the proximal phalanx should normally pass through the centre of the metacarpal head. Previously, the author has shown that with angles greater than 169°, remodelling to a normal DHA is expected. However, the remodelling capability of the proximal phalanx with angles less than 169° was uncertain. In this paper, the author presents a five-year retrospective study of eight late referrals (four to six weeks post-injury) with a persistently displaced proximal phalanx fracture, all presenting with a DHA less than 163°. While all patients were offered surgery to improve the deformity, it was declined in these eight cases and the children were managed conservatively, using their hands freely with no further use of strapping or splinting. At the time of presentation, the DHA was between 158° and 163° and sequential radiological follow-up demonstrated that the DHA had normalized in seven of the eight patients. The eighth patient had a persistent deformity, with a DHA of 175.7° at two years. However, the parents of the child were satisfied and did not return for further follow-up. Classically, we are taught that remodelling best occurs in the plane of the joint and that a coronal deformity may not remodel adequately. However, while this is a small case series, it demonstrates that even with deformities of 20° in the coronal plane, remodelling of these injuries is both reliable and predictable in most. This is particularly important where patients may present late with an established deformity that would not be amenable to easy close reduction in the clinic. In this group of patients – regardless of whether the fracture is through the physeal plate or immediately adjacent to it – the authors suggest that an initial conservative approach to treatment is safe and would allow remodelling. In the case of

the single patient who did not completely remodel radiologically, the clinical impact of a 4° ulnar deviation at the base of the proximal phalanx is so minimal as to not cause functional or cosmetic issues, and is therefore unlikely to necessitate surgical treatment. Despite the small numbers of patients and low evidence level, the author of this case series has contributed a useful piece of information.

## Splinting for pain and function in thumb carpometacarpal osteoarthritis

■ Arthritis at the base of the thumb is an extremely common problem faced by hand surgeons and hand therapists alike, and is thought to be encountered by over a third of women over the age of 50. When present, first metacarpal phalangeal joint osteoarthritis (MCPJ-OA) can interfere significantly with health-related quality-of-life. There are numerous non-surgical treatment methods available, one of which is splinting, which is cheap, non-invasive, and avoids some of the complications of other interventions, but requires the patient to be compliant and undertake continued use. There have been multiple systematic reviews in the past, including a Cochrane review, but these have found little high-quality evidence, limiting the scope for meta-analysis and recommendations possible. An up-to-date and well conducted systematic review has been performed by these authors from **Dunedin (New Zealand)** with the aim of establishing where we are in the evidence for conservative management of MCPJ-OA.<sup>2</sup> The study team screened over 1300 titles, identifying and reviewing 12 articles in detail that were potentially suitable for inclusion. Of these, four were included in a meta-analysis comparing splint treatment *versus* no splint, and an additional eight articles were included in a narrative section. The included studies represented a broad range of sex, ethnicity, and employment status, and examined two interventions of simple splint *versus* no splint, as well as a comparison of different splinting designs and materials. Outcomes reported were variable throughout the studies but included pain scores and functional outcome measures. As one would expect, there was a varying degree of bias demonstrated within the included studies. Overall splinting appeared to improve pain and function in the medium term (three to 12 months) compared with no splinting, although interestingly this difference was not observed in the short-term reported outcomes (zero to three months). When considering different types of splint, those splint

designs that incorporated the metacarpophalangeal joint demonstrated worse function in the medium term (three to 12 months) than those splints leaving the metacarpophalangeal joint free. However, there were no other observed differences between different splint designs or materials for patient-reported pain or function. What this comprehensive and well-performed review suggests is that splinting is a useful adjunct for thumb base arthritis, having a moderate-to-large effect on pain symptoms and a moderate effect on function. While results did not extend beyond 12 months following initiation of splint, this is obviously an important part of the management armamentarium and its effectiveness is limited by patient tolerance and compliance. The durability of the effect is dependent on the duration of treatment, and so other options may be better for some patients. For most, however, this review suggests that splinting should probably be the first-line treatment.

## Extra-articular fractures of the fifth metacarpal X-ref

■ Another noteworthy systematic review that crossed the editorial desks at 360 this month carries with it an important lesson in the principle of external validity. Authors from **Oxford (UK)** performed a comprehensive and robust review of the management of closed adult extra-articular fifth metacarpal fractures.<sup>3</sup> This was prospectively registered with PROSPERO (International Prospective Register of Systematic Reviews) and performed in line with the guidance from the Cochrane Handbook for Systematic Review of Interventions and the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. From an original list of 980 screened articles, 43 were reviewed in full. The inclusion criteria for this systematic review were exacting and demanded that studies were prospective and randomly compared operative and nonoperative techniques. From these 43 articles, only two were included for analysis. Despite the title implying that all extra-articular fifth metacarpal fractures were included, both of the studies assessed results in fifth metacarpal neck fractures, thereby narrowing down the scope of the review considerably. The first study compared 40 patients who were randomly treated with operative fixation using an intramedullary Kirschner wire (K-wire) technique or nonoperative management who underwent closed reduction, initial immobilization in a palmar splint, and then functional mobilization in a brace for five weeks. Final follow-up

was reported at 12 months post-injury. The second study randomized 85 patients to either an intramedullary K-wire technique or nonoperative management consisting of cast immobilization and buddy taping; this study was powered to detect an eight-point difference in the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score at 12 months follow-up. Combined analysis of the results of these papers demonstrated no difference between objective clinical and radiological outcome measures at 12 months. Operatively treated patients were more likely to suffer an adverse event (chronic pain, cold intolerance, K-wire extrusion, infection, loosening, delayed wound healing, and complex regional pain syndrome) than those who were treated nonoperatively. These findings would appear to demonstrate no benefit to operative fixation over nonoperative measures for fifth metacarpal neck fractures, which is likely to be in line with much of the hand surgery practice in the United Kingdom. These findings should not be extrapolated to all extra-articular fifth metacarpal fractures, as there was insufficient evidence identified during the review to make comment on these injuries. The metacarpal is a long bone and it should be noted that, just as a femoral shaft fracture is a different entity to an intertrochanteric fracture, different metacarpal fracture patterns should not be lumped together in either trials or systematic reviews. The authors conclude that further high-quality evidence is needed in this field to determine the best management of these injuries; here at 360, we would strongly agree.

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### A genome-wide association analysis identifies 16 novel susceptibility loci for carpal tunnel syndrome

■ It is rare for us at 360 to get excited about a genetics paper, but our interest was piqued by this genome-wide study from **Oxford (UK)**, which looks at potential susceptibility loci for carpal tunnel syndrome.<sup>4</sup> Every hand surgeon knows the prevalence of carpal tunnel syndrome, the classical pattern of its symptoms, and the severe impairment experienced by patients. What remains poorly understood is the pathophysiology behind the onset of carpal tunnel syndrome. Genetic factors have previously been discussed in twin and sibling studies, but the actual source of this apparent trait has not yet been identified. Furthermore, the contribution of other systemic conditions, such as diabetes, rheumatoid arthritis, and hypothyroidism – as well as the potential relationships with work or activity – makes definition of the cause of carpal tunnel syndrome even more difficult. Genome-wide association studies (GWAS) could be considered as the ‘big data’ of genetics. In GWAS research, the whole of each individual’s genome is sequenced and computer analysis techniques are used to ‘associate’ specific genes to conditions in the disease and non-disease cohorts. These studies have become the go-to method for establishing the most likely genes implicated in a condition and have the advantage that they are able to pick up multiple potential implicated genes. Using data from the UK Biobank – a prospective cohort study of approximately 500 000 individuals who have all undergone whole genome genotyping and have linked the genetic data with their medical records – the authors searched for markers within the genome that were present in carpal tunnel syndrome patients (12 312) but absent in those without a diagnosis of carpal tunnel syndrome (389 344). There were genome-wide significant associations seen ( $p < 5 \times 10^{-8}$ ) at 422 variants across 16 individual loci. These specific loci were then mapped to 25 genes that variably (depending on the computational method) appeared to be associated with carpal tunnel syndrome. Most of these genes are implicated in the biology of core extracellular matrix glycoproteins, collagens, and proteoglycans. Many had previously been related to the phenotypical presentation of height and waist circumference, and this was confirmed with subsequent correlations between the expression of these genes and body mass index. There were weaker correlations between these genes and the clinical diagnoses of rheumatoid arthritis, gout, and type II diabetes. There was a

negative genetic correlation between height and carpal tunnel syndrome. Interestingly, overall carpal tunnel syndrome patients were 2 cm shorter than controls across both sexes. Secondly, the authors sampled the tenosynovium from 41 patients undergoing carpal tunnel decompression surgery. Using the samples, they undertook RNA expression analysis to determine if there were identifiable patterns to expression of the candidate genes. They then demonstrated significant upregulation of these genes when compared with that found in the skin of healthy individuals. In addition, there appears to be a positive correlation between the genetic risk score and the requirement for carpal tunnel release surgery, which was used as a marker of symptom severity. Ultimately, the exact pathophysiology of carpal tunnel syndrome remains unknown. Whether the genetic risk factors identified alter the environment through which the median nerve transits, or the susceptibility of that nerve to the effect of compression, is still to be answered. However, the interrogation and careful analysis of ‘big data’ is an interesting avenue and may help to address seemingly unanswerable questions, especially when supplemented by targeted gene expression studies.

### The Net Promoter Scores with Friends and Family Test after four hand surgery procedures

■ The measurement of the success of our treatments and interventions is an important part of justifying our approach, in terms of both clinical benefit and financial cost. Outcomes measurement is an area of research that continues to be developed and many tools have been described. Outcome measures can be broadly divided into patient-reported outcome measures (PROMs), objective measures, health-related quality-of-life scores, and satisfaction measures. In terms of satisfaction scores, a relative constant across specialties is the Friends and Family Test, which is based upon the Net Promoter Score (NPS). The Friends and Family Test was adopted by the NHS in 2012 in an attempt to standardize a simple measure capable of assessing overall satisfaction with not just a treatment, but the whole healthcare experience. The concept is that patients are asked a simple question, “Would you recommend this treatment to friends and family with a similar condition?” These authors from **Dunfermline (UK)** have used the NPS to assess satisfaction with their surgical interventions for carpal tunnel syndrome, trigger finger, Dupuytren’s disease, and ganglion surgery, alongside a PROM, the

Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire.<sup>5</sup> The NPS grades the 'friends and family' recommendation between 0 and 100, categorizing those scoring above 90 as promoters, those between 70 and 89 as passives, and those below 70 as detractors. The overall NPS is then defined as the percentage of detractors subtracted from the percentage of promoters. Of 1012 patients who underwent surgery under the care of a single surgeon, for the included conditions between 2014 and 2017, 810 (80%) completed the outcome measures at a mean of 14 months postoperatively. There were 467 carpal tunnel releases, 103 trigger finger releases, 224 Dupuytren's surgeries, and 16 ganglion excisions. Examining the NPS, trigger finger release was the best-performing procedure (NPS = 83), followed by carpal tunnel release (NPS = 68) and then Dupuytren's surgery (NPS = 62). Ganglion excision scored 44 but it was recognized that this was a small sample of patients. The parallel measurement of the QuickDASH presents some interesting comparisons. There were significant improvements in the QuickDASH for both trigger finger and carpal tunnel release, but no improvements seen for Dupuytren's surgery or ganglia/cyst excision. The authors rightly question whether PROMs like the QuickDASH, given their focus on pain relief and limited inventory items focusing on hand function, are suitable for use in Dupuytren's disease, which is often considered a painless condition. Using a linear regression model, the authors also demonstrated that preoperative QuickDASH, postoperative change in QuickDASH, and overall hospital satisfaction all independently predicted the NPS, with change in PROM accounting for 7% of the variation observed and hospital satisfaction accounting for 27%. Although this is a single-surgeon case series, the work provides compelling evidence that patients consider these procedures to be sufficiently effective and tolerable to recommend them to friends or family. This would question the label of 'procedures of limited clinical value' that has previously been associated with these interventions. It also questions how appropriate the PROMs used are to detect changes in this patient cohort.

### **Bennett fractures: a biomechanical model and relevant ligamentous anatomy**

■ The Bennett's fracture is a fracture of the base of the thumb metacarpal. Due to the palmar beak ligament, it usually displaces dorsally and leaves the partial articular fragment in the joint, resulting in luxation or dislocation of the majority of

the joint. We are taught that the palmar beak ligament (otherwise known as the anterior oblique ligament) is attached to the fracture fragment in Bennett's fracture dislocations at the base of the thumb metacarpal, explaining this observed phenomenon. However, this has been contested by anatomical and histological examinations that suggest the anterior oblique ligament, rather than having a robust structure, is thin and more akin to joint capsule. These authors from **Redwood City, California (USA)** have used a cadaveric model to explore the ligamentous anatomy of Bennett's fractures.<sup>6</sup> After developing their model using cadaveric specimens, they created classic Bennett's fracture patterns in six cadaveric thumbs from three adult males. During development of the model, they observed that Bennett's fractures occurred when the first metacarpal was loaded in a grip-like position. Fractures were first observed fluoroscopically and then dissected. Prior to dissection, the fractures were all noted to be at least 2 mm displaced. There were no trapezial fractures or pure dislocations of the carpometacarpal joint observed. Attempted reduction under fluoroscopic guidance and then direct visualization was confirmed to be most effective with the manoeuvre of radial abduction and pronation of the thumb. Dissection of the fractured specimens demonstrated that the anterior oblique ligament had a broad attachment but was universally thin in quality. This was in comparison with the ulnar collateral ligament, which was more robust and universally attached to the palmar beak fragment. The broad insertion of the anterior oblique ligament was primarily attached to the metacarpal base, with only a small proportion attached to the palmar beak fragment. There are obvious flaws to this study, including the number of specimens. Perhaps most importantly, the author's injury mechanism is not the only way of creating a Bennett's fracture dislocation, as other wrist and thumb positions, and loading thereof, may produce differing fracture patterns. However, it seems unlikely, given the broad insertion and thin composition of the anterior oblique ligament, that this structure is heavily implicated in dictating beak fracture morphology, and it is probable that the ulnar collateral ligament is more heavily implicated than had been previously thought. This small observation does, to a certain extent, explain the more successful reduction manoeuvres and may also help guide treatment, as a fuller understanding of the pathophysiology will help with selecting candidates for operative and conservative treatments.

### **Thumb opposition recovery following release for severe carpal tunnel syndrome**

■ Carpal tunnel syndrome is the most common peripheral nerve entrapment syndrome. It is a constellation of different presentations and symptoms, with pain, paraesthesia, and weakness presenting in varying proportions and timeframes in each individual patient. For many, carpal tunnel syndrome is little more than a painful annoyance that bothers them in the morning, is self-limiting, and requires no more treatment than advice and possibly an injection. For others, carpal tunnel syndrome is a debilitating condition with loss of thumb power, permanent motor loss, and severe disability in the hands. There is, of course, every imaginable combination between. For patients presenting with permanent sensory loss and abductor pollicis brevis wasting, it is generally accepted that they have a poor prognosis in terms of regaining function following carpal tunnel release surgery, to the point that many centres will not offer the intervention. The presumed axonotmesis that has occurred due to prolonged severe pressure on the nerve would suggest that nerve function and recovery would be incomplete even following release. Researchers from **Delhi (India)** have challenged this presumption and carefully assessed 22 patients with severe carpal tunnel syndrome, all of whom had loss of sensibility in the median nerve distribution, thenar atrophy, and inability to oppose the thumb on clinical examination preoperatively.<sup>7</sup> All patients were assessed preoperatively and at six months postoperatively using electrophysiological studies, MRI neurography (capable of assessing the denervation oedema within the abductor pollicis brevis, and cross-sectional area and morphology of the median nerve and motor branch), and clinical measurements of grip strength. Preoperatively, symptoms had been present for a median of 12 months, and all patients underwent a standard carpal tunnel release. Contrary to expectations, there were some improvements observed following surgery in this small cohort. All measurements of thumb strength significantly improved – including tip-tip pinch, lateral pinch, three-point pinch, grip, and thumb opposition – although all improvements were small and may not be clinically significant to the patients. The morphology of the median nerve did not alter with surgical release, although the motor branch morphology and denervation oedema within abductor pollicis brevis both improved. There was also a statistically significant improvement in electrophysiological activity of abductor pollicis brevis. This small study would suggest that recovery following

carpal tunnel release in severe cases is possible. Furthermore, simultaneous reconstruction of thumb opposition with an opponensplasty may be unnecessary in these patients. This is a group for whom no clear solution is available and, based on the results presented here, it seems that more work is warranted in this area with follow-up of longer than a year.

### False-positive rates for investigations of carpal tunnel syndrome

■ The majority of experienced clinicians will agree that the overall diagnosis of carpal tunnel syndrome is a clinical one. Taking into account factors from the history, physical examination, provocation signs, and specialist investigations where appropriate – usually EMGs, but occasionally MRI and ultrasound – is the most reliable way to reach the diagnosis. However, with the continued transition towards a value-based healthcare economy, healthcare ‘payers’ are increasingly insisting on positive investigations and failed conservative management before they will fund operative release. The problem with this approach is that none of the investigations are 100% sensitive or specific. In current practice, the use of electrophysiological or radiological investigations in the diagnosis of carpal tunnel remains hotly debated. At different centres, these investigations may be considered as essential prior to referral to a specialist, confirmatory once referred, or performed where doubt concerning the diagnosis may exist. Electrophysiological examination may be time-consuming and considered painful by some; however, it directly measures nerve function, which is ultimately the variable of interest. Radiological measurements – commonly ultrasound but also

MRI – can act as a surrogate for nerve function, usually by measuring the cross-sectional area of the nerve proximal and distal to the transverse ligament. Authors from **Pittsburgh, Pennsylvania (USA)** have sought to determine the false positive rate of both electrophysiological studies and ultrasound scanning in individuals with no clinical suggestion of carpal tunnel syndrome, which remarkably is not currently known.<sup>8</sup> They reviewed the investigation results of 40 hands that had been referred for electrophysiological examination for a diagnosis of either cubital tunnel syndrome or cervical radiculopathy. All patients were screened using the CTS-6 tool. This validated diagnostic tool seeks to determine the risk of carpal tunnel syndrome by assessing six criteria: numbness and tingling in the median nerve distribution, nocturnal numbness, weakness and/or atrophy of the thenar musculature, a positive Tinel sign, a positive Phalen test, and reduced two-point discrimination. The factors do not carry identical weightings but a score greater than or equal to 12 confers an 80% risk of carpal tunnel syndrome. Included patients had a CTS-6 score of 0, indicating a negative answer to each of the criteria. Of the 40 patients, 20 had negative electrophysiological and ultrasound investigations. Using the CTS-6 score as a benchmark, there was an overall false positive rate of 50%. Electrophysiological testing had a higher rate (43%; 95% confidence interval (CI) 26 to 59) than ultrasound (23%; 95% CI 9% to 36%). When using a confirmatory test, clinicians seek investigations with a low false positive rate. That both these investigations were positive, despite an absence of symptoms suggesting carpal tunnel syndrome, raises questions regarding their ongoing use in this role.

Whether these investigations represent subclinical carpal tunnel syndrome is unclear; if they do, the clinical implications and prognosis for that patient is not currently known. Given the use of the CTS-6 as a benchmark, we at 360 will continue to use old-fashioned history taking and clinical examination as our primary diagnostic tool.

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## Shoulder & Elbow

**X-ref** For other Roundups in this issue that cross-reference with *Shoulder & Elbow* see: *Hip Roundup 5*; *Research Roundup 5*.

### Serious adverse events and lifetime risk of reoperation after elective shoulder arthroplasty

■ In a month of headline papers on large joint arthroplasty (see the Bristol group papers in *The Lancet*), we were delighted to see this paper from the team in **Oxford (UK)**, which looks at the outcomes of shoulder arthroplasty across the UK using large data methods.<sup>1</sup> The number of total shoulder arthroplasties (TSA) performed

worldwide has increased significantly over the last two decades, with the number of reverse polarity prostheses, in particular, growing at an increasing rate. As with all relatively new healthcare interventions, a phenomenon described by ‘Scott’s parabola’ will likely occur – and this article is certainly one to pour some water on unfettered expansion. The study was designed to evaluate both the survival of TSA and serious adverse events in patients undergoing TSA. The NHS England hospital episode statistics dataset were interrogated, and 58 000 elective TSAs performed in almost 52 000 adults above the age of 50 years between April 1998 and April 2017 were found. The overall

lifetime risk of revision was calculated, and the rates of serious adverse events at 30 and 90 days post-surgery were recorded. Unsurprisingly, the number of TSAs per year increased more than five-fold during the study period. Age and sex stratification showed that the lifetime risk of revision surgery varied from 2.7% in women aged over 85 years, to 23.6% in men aged 55 to 59 years, with the risk of revision highest during the first five years after surgery. The risk of a serious adverse event was 3.5% at 30 days and 4.6% at 90 days and these were unsurprisingly associated with increasing age and comorbidity, but also male sex. The category of serious adverse events included pulmonary