

# ROUNDUP<sup>360</sup>

## Trauma

### Open foot fractures: worse than they look?

■ Despite the potential life changing sequelae of an open foot fracture, relatively little is known about the epidemiology or long-term outcomes of significant open foot injuries. Just like buses, we have two significant series reported in this month's 360. Much of the demographic and epidemiological studies of modern trauma have come from **Edinburgh (UK)** and the tenacious chaps north of Hadrian's wall have again stepped up to the mark with a 23-year epidemiological study of open foot injuries. The investigators used the trauma registry of a single tertiary referral centre serving 530,000 adults, undertaking a population study with the aims of establishing the epidemiology, incidence and severity of open foot injuries in a western population. Over the 23 years of the study, 348 open foot injuries were treated and the investigators established three different groups within their cohorts. Nearly 70% of patients presented with a less severe (level I) open forefoot fracture. A second cohort of patients presenting with multiple forefoot fractures (level II) had higher ISS scores. The most severely injured cohort were the mid- and hind-foot fractures (level III) of whom over 65% presented with a Gustilo and Anderson grade III injury and an average ISS of 12. Level III injuries had a high amputation rate in this series (30% of mid-foot fractures and 17% of hind-foot fractures).<sup>1</sup> The research team have identified an injury scale that is consistent with other markers of injury severity (ISS, and

Gustilo and Anderson grade). Given the high complication rates and young age (only 13% were over 65) we would tend to agree with the conclusion of the authors. These severe open fractures should be managed in specialist trauma centres.

### The diagnostic accuracy of continuous compartment pressure monitoring

■ Long-term advocates of continuous compartment pressure monitoring, the **Edinburgh (UK)** group present an interesting study with the aim of assessing the diagnostic accuracy of compartment pressure monitoring in patients sustaining a diaphyseal tibial fracture. The research team designed a prognostic study using a retrospective cohort of patients (Level I prognostic study). All 1184 patients included in the institution's trauma registry with a diaphyseal tibial fracture were included in the study. Of these, 979 were identified as having compartment pressure monitoring in situ. Patients underwent a fasciotomy if they had elevated intracompartmental pressure and a differential perfusion pressure of less than 30 mmHg. The diagnosis of true compartment syndrome (true positive) was reached if there was escape of the muscles, colour change or necrosis intra-operatively. A false positive diagnosis was reached if the wound could be closed before 48 hours. True negative diagnoses were defined as patients with an uncomplicated course, and a false negative as patients who either underwent

fasciotomy with normal pressure readings or patients with the late sequelae of compartment syndrome (contracture or neurological injury) at final follow-up. This study included 979 monitored patients, of whom 850 met the inclusion criteria. Of these patients, a whopping 17.9% (n = 152) underwent a fasciotomy for compartment syndrome; only six of these were felt to be false positives and five were false negatives. Of the cohort of 689 patients who did not have a fasciotomy, nine (1.3%) had subsequent symptoms of a potential missed compartment syndrome (false negatives). Based on these results the compartment pressure monitoring system has a sensitivity of 94% and specificity of 98%, while the positive and negative predictive values were 93% and 98%, respectively. Our boffins here at 360 were interested to read this fascinating paper and, aware that this is a highly controversial topic, were amazed to see fasciotomy rates of over 17% (compared with large RCTs such as SPRINT where 0.8% (n = 7/862) underwent fasciotomy at a range of major centres across North America. The high rate of fasciotomy does potentially give cause for concern, as does the definition of true positive and false negative used in this study. A patient may have a fasciotomy without established compartment syndrome (i.e. the muscle is still being perfused), but the skin is not suitable for closure (contused, degloved or simply swollen) by 48 hours, in the same way that a

patient may have a concomitant neurological injury or muscle damage leading to contracture at the time of injury, lowering the reliability of both the false positive and true negative diagnoses.<sup>2</sup> It is extremely difficult to jump to conclusions with a study like this where the 'gold standard' diagnosis is a clinical one, but it certainly seems likely that the specificity of continuous pressure monitoring is overestimated in this study.

### Conservative treatment ok for supracondylar fractures

■ In many centres throughout the world, type II supracondylar fractures are treated with either operative intervention or closed reduction (e.g. with a high arm sling). There is little data surrounding completely conservative treatment of these injuries, and in particular the long-term functional outcomes are not known. Surgeons in **Madrid (Spain)** have been treating these injuries simply with splint application, without reduction. In order to establish the efficacy of their treatment regime they designed a retrospective cohort study (Level IV evidence). Outcomes were assessed using clinical review, radiological assessment (Bauman, carrying angle) and clinical outcome scores (Mayo score, Flynn criteria and Quick DASH score). A total of 46 patients were included in the study with an average age of 5.5 years with a mean of 6.5 years' follow-up. Humerocapitellar angle improved from presentation (mean 12.8° to 30.5°), however, there was a significant loss of 5° of flexion and

a related increase of 5° in extension between injured and uninjured sides. There was also a clinical and radiological change in carrying angle between injured and uninjured elbows at final follow-up of around 5°. As one might expect, these minor changes in radiological and clinical outcomes were not reflected in any clinically relevant differences in the functional outcome scores, with Mayo elbow performance scores of over 95%, and over 80% achieving satisfactory results on the Flynn criteria.<sup>3</sup> This paper highlights for us that there is certainly still a place for conservative treatments for these injuries, although it is important to treat each patient as an individual and remember that Gartland II fractures are a spectrum of presentations. This paper would suggest that at least 80% of the time (and perhaps more in selected cases) an excellent result can be achieved even without reduction of the fracture.

### High complication rates in patellar fractures

■ The high tension environment of the extensor mechanism combined with the subcutaneous nature of the patella itself can make patellar fractures challenging fixations to perform. Traditional AO teaching advocates the stabilisation of these fractures via an anterior tension band construct, although both screw and plate fixation is also in common use. Researchers from **Torrance (USA)** designed a retrospective comparative cohort series (Level III evidence) to establish the differences in complication rates between K-wire and cannulated screw fixation. Failure of fixation necessitating further surgery was the primary outcome measure, with secondary outcomes including the need for metalwork removal and infection rates. The research team were able to report on the results of 448 patients of whom 70% (n = 315) underwent tension band fixation and 30% (n = 133) cannulated screw fixation. At final follow-up the complication rate in the screw fixation group was significantly higher than in the

K-wire group (3.5% versus 7.5%) while the counter was true with regards to infection (3.5% K wires versus 1.5% screw fixation) and implant removal (37% K-wire versus 23% screw).<sup>4</sup> While both methods of fixation provided a relatively low complication rate, the high rates of implant failure were concerning. The authors carried out a more sophisticated analysis to adjust for potential confounders which suggested there was no difference in failure rates between the two methods. Given this further analysis, we would certainly conclude that the cannulated screw method has the edge with a 50% reduction in the likelihood of symptomatic metalwork occurring.

### The unanswered question

■ There are 34 randomised controlled trials regarding the distal radius indexed on PubMed, and many more in preparation, making this perhaps one of the most studied questions in trauma (or orthopaedics as a whole, for that matter). Yet still a definitive answer to the question of best treatment for any particular fracture continues to elude traumatologists the world over. With this bewildering array of evidence, reaching an answer to even a simple question becomes more complex - an ideal setting for a meta-analysis. Researchers in **Toronto (Canada)** have performed a meta-analysis aiming to answer one of the myriad unresolved research questions surrounding distal radius fractures, namely, 'is external or internal fixation better?' The research team identified 52 trials that would be potentially suitable for inclusion, but only ten met the strict inclusion criteria. The researchers performed pooled analysis for DASH scores, ulnar variance and infection, all of

which significantly favoured the ORIF group. The remainder of the pooled analysis for clinical outcomes did not demonstrate clinically significant differences.<sup>5</sup> In contrast to many systematic reviews and meta-analyses, these authors were able to identify high quality homogenous data to perform conclusive pooled analysis. Based on their results one can expect better functional outcomes, better restoration of anatomy, and lower infection rates with plate fixation. We are certainly convinced here at 360.

### Vitamin D and fracture

■ There is accumulating evidence that vitamin D deficiency in certain populations may contribute significantly to fracture risk. Recent studies evaluating vitamin D levels in proximal femoral fractures have identified high rates of dietary deficiency. Vitamin D deficiency has not traditionally been associated with North American populations, however, researchers in **Eugene (USA)** conducted a retrospective population cohort study at a local Level II trauma centre. A total of 201 patients undergoing fracture fixation surgery were also tested for serum 25-hydroxyvitamin D levels. There were two patient cohorts (103 winter and 98 summer). All underwent a standardised laboratory test for vitamin D (normal range 32 ng/mL to 80 ng/mL). Surprisingly high levels of vitamin D deficiency were identified in the fracture cohorts. Mean serum vitamin D was significantly higher in the summer cohort (29.8 ng/mL versus 26.4 ng/mL) but both were below the recommended minimum.<sup>6</sup> This finding of high levels of vitamin D deficiency across the entire fracture population in a North American centre requires further study. Although a relatively small cohort from

a small centre, the results are really quite troubling. A much larger study is definitely called for here.

### Better function with K-wires

■ Manipulation with or without Kirshner (K) wiring is one of the most common procedures undertaken in paediatric trauma surgery. However, opinions differ on the need for an additional K-wire, some surgeons arguing that a well-applied above-elbow plaster supplies more than ample stability to the fracture and there is no need to run the gauntlet of K-wire associated complications. Others do not agree. Surgeons from **Rotterdam (The Netherlands)** have decided to answer this question once and for all with a randomised controlled multicentre trial (Level I evidence). All patients aged under 16 years with a displaced metaphyseal fracture of the forearm were eligible for the study if the fracture was deemed 'stable' after reduction by the treating surgeon. All patients received an above-elbow moulded plaster and were randomised to the addition of K-wires. The study's primary outcome measure was re-displacement of the fracture. A total of 128 patients were enrolled in the study and 61 were allocated to K-wire fixation. The investigators managed to achieve an impressive 96% follow-up rate at a mean of seven months. The functional results were superior in the pinning group (6.9° versus 14.3° loss of pronosupination) and lower secondary slip rate (8% versus 45%). However, the pinning group suffered a higher complication rate (23% versus 1.5%).<sup>7</sup> We have to agree with the authors of this paper that perhaps "the frequently seen complications of pinning might be reduced by proper surgical technique". It is hard to recommend a treatment with a near complication rate to a patient of 1:4. We wanted to be bowled away by this paper and would have been ready to base our paediatric forearm fracture decision-making on the evidence. Sadly, there are a couple of significant flaws. The complication rate is an order of magnitude



higher than that reported elsewhere in the literature, and the follow-up is simply not long enough for remodeling to occur. It would be difficult to recommend one treatment or another based on the data presented here. Perhaps a longer-term follow-up paper with a more thorough examination and scoring of upper limb follow-up will be forthcoming. We hope so.

#### Tensionless bands?

■ One of the core principles of fracture fixation still avidly expounded by the AO foundation is that of the tension band, a fixation method of choice for many in the olecranon and patella, and less commonly used than tension band plates. There have, however, been mutterings of late, started by some basic biomechanical papers conducted with saw bones, that all may not be quite what it seems with the humble tension band wire. Researchers in **Maastricht (The Netherlands)** have noticed a number of failures in their clinical practice, and, combined

with the aforementioned dissenting papers, designed a cadaveric model to test the hypothesis that a tension band construct would provide compression across a fracture site, with active flexion and extension following fixation. The investigators used six cadavers and took 30 tension measurements in flexion and extension. In none of the simulations was any compression noted with active flexion of the elbow. However, the investigators did not observe compression of the fracture with active extension of the joint. Active extension caused compression up to 0.51 MPa at the articular surface. The investigators noted that the tension band principle only appeared to work between 30° to 120° of active extension.<sup>8</sup> We do wonder if the investigators have slightly missed the point with the tension band principle. Their results elegantly demonstrate that active extension (i.e. distraction at the fracture site) causes compression at the articular surface. However, here

at 360 we rather find ourselves asking, 'so what?'. While clearly we wouldn't want to believe anything that is incorrect, there are countless clinical papers and a wealth of experience demonstrating that the tension band is an excellent way to fix an olecranon fracture. The results here demonstrate that tension is indeed converted into compression. We are prepared to believe that the biomechanics may not be what they appear, but we would be keen to have an alternative mechanism proposed; at the end of the day the bone heals by primary bone healing, therefore surely compression must have been achieved somehow?

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