

ROUNDUP³⁶⁰

Foot & Ankle

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Operative treatment of calcaneal fractures advantageous in the long term?

■ The management of displaced intra-articular calcaneal fractures continues to provoke debate. On the one hand complications from operative management continue to be of great concern, with wound breakdown and infection resulting in particularly poor outcomes. On the other hand the complications of arthrosis, subfibular impingement and altered hindfoot mechanics seem more likely following non-operative treatment. The lack of clarity surrounding the best treatment isn't due to a lack of studies, there are numerous case controlled and randomised controlled trials, many with conflicting results but few with long-term follow-up. Researchers in [Umeå \(Sweden\)](#) have added their two-pennies with their recent long-term reporting of a randomised controlled trial (Level 1 evidence). Unlike the majority of studies, this one was designed to investigate the long-term arthrosis rates. Their study compared operative and non-operative treatment of displaced intra-articular calcaneal fractures. They included 82 patients treated at five trauma centres across Sweden over a four-year period. Patients were randomised to either operative or non-operative

treatment and were eligible for the study if presenting with a displaced intra-articular calcaneal fracture with over 2 mm of displacement. The primary outcome measures for the study were VAS scores for pain and function, with secondary outcomes of AOFAS score and the Olerud-Molander scale. Unusually (and currently different to other studies), the authors followed the patients up for eight to 12 years, reasoning that when the indication for fixation is to avoid secondary arthrosis, the patients need to be followed up long enough for the arthrosis to develop. The authors successfully recruited and randomised 42 patients to the operative and 40 patients to the non-operative, group. The study groups were comparable with regards to fracture type and demographics, and follow-up was successful at a year in 76 patients and eight years in 58 patients. Like other studies, the authors did not detect a difference in primary outcomes or radiographic incidence of subtalar arthrosis at a year, however, by final follow-up (eight to 12 years) there was a difference in subtalar arthrosis incidence (41% risk reduction with fixation *versus* non-operative treatment) and borderline significant differences with respect to VAS scores and the physical component of the SF-36.¹ While it is always dangerous to accept 'borderline' significant results, and this study probably suffers from follow-up bias (patients doing particularly poorly are more likely to return to follow-up) and will not be at power by final

follow-up, we found these results really interesting. Expert opinion is divided on calcaneal fractures and perhaps the largest disagreement surrounds operative intervention for displaced intra-articular fractures. Previous studies have focused on short-term outcomes, and allowing for the limitations here, this is (to our knowledge at 360) one of the longest-term follow-up studies and confirms what one might think. Post-traumatic arthrosis becomes more common with longer follow-up, and in the longer term these observed differences become more pronounced. It certainly seems that the final chapter has not yet been written in the story of calcaneal fractures.

Varus ankles and arthroplasty

■ In a procedure with some mixed results and imperfect longer-term outcomes (see the registry review feature), surgeons are naturally inclined not to push the envelope with indications. Patients with pre-operative varus deformity can complicate ankle arthroplasty surgery considerably. With a reported increase in failure rates and increased technical difficulty associated with ankle arthroplasty in patients with greater than 20° of talus varus deformity, surgeons are often hesitant to undertake surgery in these cases. The surgical team in [Wollongong \(Australia\)](#) designed a prospective comparative case-matched series (Level II evidence) with the aim of establishing if patients with varus deformity (in this case >10°) had poorer outcomes following total ankle

arthroplasty (TAR) for osteoarthritis. They report 63 consecutive unselected patients undergoing total ankle replacement. Thirty-six patients who had coronal-plane tibiotalar varus deformity of ≥ 10° were matched to 36 patients with less than 10° of deformity. Outcomes were assessed both pre-and post-operatively using the AOFAS ankle-hindfoot scores as well as secondary outcomes of SF-36 and Ankle Osteoarthritis Scale scores. Patients were also followed up with plain radiographs to evaluate their coronal-plane deformity. There were no differences (as would be expected in a case-matched series) with respect to age, sex, operatively treated size, body mass or prosthesis components with follow-up to just under three years for both groups. The varus group were mixed, but 50% of patients had a severe (>20°) varus deformity. There were more supplementary procedures in this group to correct deformity and achieve a plantigrade foot. The authors report improvements by over 50 points on the AOFAS in both groups, with the varus group outperforming the neutral group. The varus group were able to be almost completely corrected towards a normal weight bearing axis and there were overall no differences in scores or complication rates between the two groups.² It does seem that, based on these results assuming varus ankle arthroplasty is combined with a suitable soft-tissue procedure to achieve a balanced neutral ankle, the results are comparable with

a 'normal' neutral ankle. TAR is a developing procedure with better and better results as the years go on. It is nice to see a re-examination of some of the early indications given the development in the procedure and implants that has occurred over recent years.

Reducing autograft complications in foot and ankle surgery

■ In all areas of orthopaedic surgery where bone graft is used, the problems with donor site morbidity raise their ugly heads. Some studies report up to 30% complication rate associated with graft harvest, and in a world with increasingly advanced ceramic and growth factor substitutes, more and more surgeons are looking for a solution to avoid the issues with graft harvest. While the various types of bone graft substitute offer combinations of the structural, osteoconductive, osteoinductive and osteogenic properties offered by autogenous bone graft there is currently no widely accepted bone graft substitute that offers all of these characteristics. Researchers based in **Rhode Island (USA)** have reported a collaborative randomised controlled trial (Level I evidence) aimed at assessing the value of a combination therapy of a ceramic osteoconductive matrix beta-tricalcium phosphate (β -TCP) combined with a recombinant human platelet-derived growth factor (rhPDGF-BB). The study team were able to recruit 37 trial sites across North America, who between them enrolled a total of 434 patients into a prospective, randomised (2:1), controlled, non-inferiority clinical trial. Non-inferiority trials are only powered to demonstrate 'equivalence' to current treatments and are ideally suited to establishing the suitability of a new 'substitute' treatment such as this. They included patients requiring any type of hindfoot or ankle arthrodesis where graft is required. Patients were randomised to either autograft or a combination of rhPDGF-BB and β -TCP. Primary outcomes were

assessed for fusion rates and safety with secondary outcomes including radiographic, clinical, functional and quality of life scores, all assessed to one year post-operatively. The study population consisted of 260 patients (394 joints) randomised to the growth factor group and 137 (203 joints) randomised to autograft. The radiographic (CT-based) fusion rates were comparable (61.2% growth factor *versus* 62% autograft), and clinically there were no differences in fusion rates (86.2% growth factor *versus* 87.6%). There were similar results demonstrating non-inferiority in nearly all secondary outcomes at both 24 and 52 weeks post-operatively. However, the complication rates were lower in the growth factor group.³ The authors conclude that in "patients requiring... arthrodesis, treatment with rhPDGF-BB/ β -TCP resulted in comparable fusion rates, less pain, and fewer side effects". While this is certainly true based on their impressive results, we do wonder if a negative control group is required to really make this the standard of care. Many surgeons undertake ankle and hindfoot fusions without recourse to bone graft with excellent results. In cases where there is severe deformity or graft is required to maintain length, this study does support the use of this growth factor matrix composite as 'non-inferior' to autograft.

The biomechanics of ECP in plantar fasciitis

■ There are many heart sink diagnoses in the orthopaedic clinic, but here at 360 the recalcitrant plantar fasciitis sufferer fills us with a particular dread. These patients experience significant pain and we have found operative intervention to be unreliable and often make the problems worse. Of the various non-operative treatments, extracorporeal shock wave therapy (ECP)

has garnered strong support in some circles and we were intrigued to see this objective assessment from researchers in **Chang Gung (Taiwan)**. They report a small case series of 12 patients, all suffering from recalcitrant plantar fasciitis. The patients had suffered pain for a mean of nine months (minimum six) and underwent ECP consisting of 1500 impulses of 0.26 mJ/mm² for three treatments over nine weeks. Outcomes were assessed using a plantar pressure assessment and gait analysis in combination with a VAS pain score.⁴ The objective measures of gait demonstrated that patients increased their walking velocity, cadence and forefoot contact pressures following ECP treatment. This, taken in combination with falling pain scores and a decreased total foot impulse as well as stance time, adds some objective gait lab data to the ongoing controversy surrounding non-operative therapies for plantar fasciitis management. It does appear the ECP not only improves symptomatic reports of pain, but also objectively normalises measurable gait parameters.

Minimally invasive first ray surgery

■ There has been much excitement surrounding the potential applications of so-called minimally invasive distal metatarsal osteotomy (MIDMO), particularly for patients with less severe deformity who may be undergoing surgery in part (or indeed on occasions, wholly) for cosmetic reasons. Despite the media and public enthusiasm surrounding this procedure, the long-term outcomes remain to be established. A surgical team in **Catanzaro (Italy)** have been undertaking the minimally invasive surgical approach for longer than others, and have reported a series of 72 patients (85 feet), all of whom underwent hallux valgus surgery using a modified Bösch MIDMO technique.

They present a prospective case series (Level III evidence). Patients were evaluated using the AOFAS score and a complete range of radiographic data including hallux valgus and distal metatarsal angle were collected, both pre- and post-operatively. The team report an impressive follow-up of over six years and were able to report excellent improvement in the AOFAS scores (from 47.6 to 87.3) and acceptable radiographic corrections. Post-operatively, the HVA decreased from 34° to 14°; the IMA improved from 14° to 6° and the distal metatarsal articular angle from 21° to 9°, all of which were significant changes. The research team identified that clinical improvements (as measured by the AOFAS) were inversely related to the severity of deformity. There was a nearly 20% recurrence rate (n = 16/85), of which nine occurred in patients with HVA >40° pre-operatively. In this series (as in other open series), recurrence was predicted by incongruent pre-operative joint space and abnormal tibial sesamoid position.⁵ Despite the impressive clinical results, this series carries with it a significant complication rate which is reported at almost 30%. It seems to us that taken in combination with the cadaveric case series by Dhukaram et al⁶ (reported in April's 360), we would question the use of minimally invasive surgery as it stands. The perceived benefit is a smaller scar and therefore the potential for lower complication rates, however, both cadaveric and clinical data suggest that with current techniques, whilst the scar may be smaller, the complication rate is in fact higher.

Alcohol: better drunk than injected?

■ Non-surgical options for Morton's neuroma include ultrasound, physiotherapy, orthotics and sclerosant or steroid injections. Of these, perhaps the most successfully regarded is the use of sclerosants, normally injected under ultrasound guidance. Despite widespread uptake of alcohol injections, there is little long-term evidence as to their benefit, and with



a condition such as Morton's neuroma where a relapsing and remitting course can be expected, long-term follow-up studies are required to establish the success, or otherwise, of treatment modalities. The surgeons in **Kingston (UK)** present one of the first long-term follow-up studies concerning the effectiveness of post-alcohol sclerosant therapy for proven Morton's neuroma. Although only a prospective case series (Level II evidence), this is perhaps the most suitable study methodology for establishing long-term outcomes in previously treated patients. The research team reviewed 45 patients who underwent alcohol therapy an average of five years previously (range 33-73 months), recording the current Johnson score and the occurrence of any complications in the intervening time. By five years the treatment had failed in over a third of patients (n = 16/45) who had undergone subsequent surgery. A further third had experienced a relapse of symptoms, with only 29% of patients remaining symptom free by five years (as measured by Johnson and VAS scores).⁷ The authors note that only in a third of patients is sclerosant therapy a definitive treatment. However, two thirds of patients did not progress to surgery and their reported complication rates were not high. In light of the findings of this study group it would be inappropriate to discuss sclerosant therapy as a definitive treatment for the majority of patients, but we are sure it has a role to play for patients who do not wish to undergo surgery, or in whom symptoms are not severe enough to justify the risks.

Is it different in the foot?

■ The foot (and hand) are unique in that the appendages of the limb have very different blood supply, developmental patterns and innervation to the rest of the limb. Patients also tend to present with the full range of diagnoses to hand or foot surgeons (rather than, say, in the leg where a children's, sports, arthroplasty or tumour surgeon may see patients with different symptoms

in the same area). Hand tumours are well characterised and many tumours behave in a unique manner in the hand to elsewhere in the body, however, there is very little known about the aetiology and natural history of foot malignancy. Tumour specialists in **Basel (Switzerland)** set out to establish a little more about sarcomas of the foot and how they differ from tumours elsewhere in the appendicular skeleton. As foot tumours are relatively rare they completed a long-term review of patients with sarcoma presenting to their unit over a 42-year period (1969 to 2008), and were able to identify 32 patients with histologically proven sarcomas of the foot. Using a retrospective study methodology they identified the diagnosis, size and delays to diagnosis along with the documented subsequent biological behaviour of the tumour. Their case series included 32 tumours, of which there were 15 chondrosarcomas, nine osteosarcomas and eight Ewing's sarcomas. Patients were followed up for an average of 11 years, and the delay between onset of symptoms and diagnosis was a worrying ten months. This was most marked in Ewing's (18 months) as compared with osteosarcoma (15 months) and chondrosarcoma (just over seven months). While the patients report a significant delay between the onset of symptoms and diagnosis, by contrast the average size of foot tumours was between five and 30 times smaller than histologically similar tumours at different sites. Although the numbers presented here are very small, the authors venture that the long-term survival and metastasis rates are similar to tumours at other sites. It does seem that in this long-term follow-up series foot tumours have a very distinct set of biological and physiological characteristics, becoming symptomatic when much smaller, but posing a diagnostic challenge leading to delays in diagnosis.⁸ The authors seem to us here at 360 to have adequately answered the question they posed in the title of

their manuscript. Malignant bone tumours of the foot behave differently to sarcomas at other skeletal sites. We doubt much more will be known about these rare and difficult to diagnose lesions for some time.

It's all about the temperature

■ Diabetic feet and their complications are difficult to manage, and as the old adage says, "prevention is better than cure". The conventional wisdom for patients with Charcot arthropathy is to cast and rest during the inflammatory phase to offload pressure areas and prevent skin breakdown. Maintaining intact skin in diabetic feet is challenging, and predicting the onset of Charcot arthropathy in patients who are profoundly neuropathic can be challenging. One of the early signs of the inflammatory phase is said to be an increase in skin temperature, however, how valuable this clinical sign is in allowing early preventative action is unclear. A review team in **Perth (Australia)** set out to examine the evidence for using skin temperature as a prognosticator for skin breakdown in diabetic feet. They performed an extensive systematic review of all papers published since 1960 in an attempt to determine the prognostic value of skin temperature changes in predicting ulceration. The researchers evaluated published data concerning the use of LC thermometers and infrared thermometers. The review team identified 127 papers in their initial search, of which only 20 pertained to the study question. Of these, nine were included with the remainder excluded due to methodological flaws. Unsurprisingly, (given the widespread acceptance of the sign) their meta-analysis demonstrated that changes in skin temperature are clearly linked to the development of neuropathic foot ulcers. The meta-analysis with a random effects model suggests that a population temperature difference of 3.36°F is associated with a risk of ulceration. The summation of evidence is that although changes in foot temperature are predictive of ul-

ceration there is no 'magic number' beyond which ulceration could be expected, and it is individual changes rather than a threshold value that are predictive of ulceration. Interestingly, the authors of the review examined the benefit of daily foot temperature monitoring which has an effect of 3.73 (with some studies reporting odds ratios of up to 8.0), suggesting that a very simple intervention of daily foot temperature monitoring (and hence early presentation prior to ulceration) can cut the incidence of diabetic ulceration significantly.⁹

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