

ROUNDUP³⁶⁰

Trauma

x-ref For other roundups in this issue that cross-reference with Trauma see: *Foot & Ankle roundups 1,4 and 8; Wrist & Hand roundups 4 and 8; Shoulder & Elbow roundup 4; Spine roundup 1; Children's Orthopaedics roundups 1,5 and 6; Research roundup 3.*

On-table CT for calcaneal fractures **x-ref**

■ Treatment of complex injuries is one of the indications for on-table 3D imaging, with proponents arguing the advantages of 3D CT scanning in terms of increasing quality of reduction, particularly in fractures where indirect reduction of a joint surface is indicated (such as in a calcaneal fracture). Researchers in **Heidelberg (Germany)** have set out to establish what benefit, if any, is conferred in terms of accuracy of reduction with intra-operative 3D CT. The research team devised a prospective study where on-table CT scans were performed after fixation and prior to closure. They assessed the benefit (or otherwise) of on-table CT by assessing the frequency of revision after obtaining the CT. Like many other studies, the authors also attempted to establish if intra-operative step influences outcome. The research team reviewed the charts and imaging of 377 consecutive patients, all of whom were operatively treated for their calcaneal fractures. Patients were included with Sanders type II and III fractures and were then divided into two groups according to the articular step-off following reduction as less than or more than

2 mm. Amazingly, the study authors report an intra-operative revision rate of 40.3% and additional reduction in nearly 1:5 patients (19.6%). They were able to report the clinical outcomes of 77 patients who had completed the American Orthopaedic Foot & Ankle Society (AOFAS) score. In counterpoint to many published papers, the research team indicated that post-operative joint surface congruence had a significant influence on clinical outcome and the degree of osteoarthritis development. The authors of this interesting study argue that the superior imaging information offered by on-table 3D CT can be used to improve patients' clinical outcome, both in terms of quality of reduction, clinical outcomes and eventual development of osteoarthritis.

Timing of femoral fracture surgery and outcomes

■ Optimal surgical timing for definitive treatment of femoral fractures has been the subject of intense scientific scrutiny for nearly two decades now. Researchers in **Dartmouth (USA)** have attempted to shed some further light on this controversial topic by examining in-hospital mortality for patients with femoral fractures in light of surgical timing, Injury Severity Score (ISS) and age.² The study authors queried the US National Trauma Data Bank and used this to evaluate in-hospital mortality for patients presenting with unilateral femoral fractures. Oddly, given the volume and quality of the data, rather rudimentary statistical analysis

was undertaken and patients were stratified into four groups for surgical timing and four groups by ISS. The authors then simply performed Chi squared testing to evaluate significant differences in mortality between the groups. The authors included 7540 patients in the study and there was an overall 1.4% mortality rate. In those patients with an isolated femoral fracture, surgical delay of more than 48 hours was associated with a fivefold increase in risk of death when compared with those operated within 12 hours (relative risk 4.8; 95% CI 1.6 to 14.1). The counter was true with severely injured patients (ISS > 26) having higher associated mortality with no delay to surgical fixation. The authors found that the association between higher mortality rates and surgical delay was even stronger in the elderly patients. This paper has a strong clinical message and supports current thinking of 'early appropriate care', however, we cannot help thinking that this paper is something of a missed opportunity. With the volume of data presented, a more refined analysis would, we feel, have led to a more robust clinical message.

Salvage arthroplasty for failed internal fixation of the femoral neck **x-ref**

■ The majority of facets of femoral neck fracture surgery have been examined, with almost all evidence levels from operative intervention choice to surgical timing. However, there is surprisingly little published in this well studied condition

concerning salvage surgery for failed internal fixation. Researchers in **Rotterdam (The Netherlands)** managed to establish a 14-centre study to investigate the outcomes of salvage arthroplasty after failed internal fixation.³ They utilised a secondary cohort study following a randomised controlled trial. Their outcomes included health-related and disease-specific quality of life (SF-12 and WOMAC score), gait pattern, and muscle strength. A cohort of patients with failed internal fixation salvaged with arthroplasty was compared with a cohort of patients who had uneventful healing following their primary fracture and fixation. The study reports a cohort of 248 internal fixation patients, of whom 68 had failed internal fixation (event rate 27%). Patients who underwent salvage arthroplasty had significantly lower WOMAC scores (73 vs 90) although SF-12 scores did not differ between the groups. Gait analysis can be subjective and difficult to interpret, however, the authors report impairment in force progression and loss of abduction strength in the salvage group. Although this paper is unlikely to guide treatment (failed fixation will always require some form of salvage), it is useful insofar as it documents the expected outcomes of a relatively understudied condition. Patients did not differ in their dependency rates or overall quality of life scores, suggesting that internal fixation and salvage, when appropriate, remain a reasonable course of action for many intracapsular fractures.

Screw insertion in osteoporotic bone [x-ref](#)

■ Torque limited screwdrivers are in common use for locking screw insertion, however, standard screws are usually inserted without mechanical torque limiting. The stability of the construct with standard screws is reliant on friction between the screw-plate and plate-bone interfaces, which in themselves are dependent on the tightness of the screws. Overtightening can cause stripping of the screw threads and loosening of screw-plate-bone interface and consequently many surgeons use the '2 fingers tight' technique. Observing that this is hardly a robust technique and is difficult to teach, surgeons in **Baltimore (USA)** set out to develop a more objective tightening regime.⁴ Their 'turn of the nut' technique is designed to be an objective screw insertion endpoint that is easy to teach, reproducible and would minimise loss of screw purchase, particularly in osteoporotic bone. Not satisfied with simply describing their technique, they then set about testing their results in a cadaveric study. The authors hypothesised that screws tightened using a 180° turn-of-the-nut (TOTN) technique would provide superior resistance to plate slippage than torque-based tightening, the 90° TOTN and the '2 fingers tight' techniques. Their study involved plate insertion to paired human upper extremities from four male and six female cadavers (mean age 84.4 ± 11.6 years). All specimens were osteoporotic (mean T-score -3.9 ± 1.0) and a 7-hole 3.5 mm narrow DCP was applied using one of four strategies: 1) 90° TOTN, 2) 180° TOTN, 3) 1.4 Nm torque limited, and 4) the '2 fingers tight' method. Outcomes were assessed using the resistance of the plate to sliding against the bone, measured using a materials testing machine. Specimens were controlled for bone mineral density, sex, and specimen clustering. Screw endpoint of slippage was assessed using a general linearised latent and mixed model. This thorough and

well designed study was, alas, a negative. The force required to slip the plate was no different with any of the four techniques, and the authors concluded that their study suggests that tightening screws using the 180° TOTN technique yields, on average, similar plate-bone friction/resistance to the other screw insertion endpoints.

Fibular intramedullary nailing on the ascendant [x-ref](#)

■ One of the most widely performed and reported operations in the trauma surgeon's toolkit is the ankle fixation (classically performed with a 7-hole 1/3 tubular plate with a separate lag screw). It

is somewhat surprising, given the frequency of ankle fractures as an injury, and the relatively common incidence of wound complications (either through wound breakdown, infection or prominent metalwork), that it is only recently that interest in intramedullary fixation has been rekindled. A clinical trials team in **Limoges (France)** designed a randomised controlled trial to compare the rate of bone union, complications, and functional outcomes between the traditional plate and screw internal fixation and intramedullary (IM) nail fixation with the Epifisa nail.⁵ Their prospective randomised controlled trial includes closed isolated fractures of the lateral malleolus with or without involvement of the medial or posterior malleolus. The study team were able to report on a total of 71 patients (mean age 53 ± 19 years) who were successfully enrolled in the study (35 in the plate fixation group and 36 in the IM nail fixation group). Surprisingly, in seven cases (19%) the nail was technically impossible and the surgeons had to convert to plate and screw fixation. In addition, there



were four patients lost to follow-up (two died, two lost), leaving 32 cases of plate fixation and 28 cases of IM nail fixation for analysis. By a year follow-up, there were no differences between groups in union or post-operative complication rates or by measured functional outcomes (Kitaoka, and Olerud-Molander scores). Despite these equivocal primary outcome measures, there were significantly fewer complications in the

IM nailing group than in the plate fixation group (7% vs 56%, respectively). Although union rates were equal between the groups, the rate of complication was substantially lower in the IM nail group. Quite reasonably, therefore, the authors

concluded that with equivocal functional outcomes and significantly lower adverse event rate in ankle fractures without comminution or syndesmotic injury, IM nail fixation of the fibula can provide reproducible results with fewer complications and improved functional outcomes.

Posterior wall acetabular fractures not all that innocent [x-ref](#)

■ Isolated posterior wall fractures of the acetabulum are the most common form of acetabular fracture. They are sometimes viewed as a 'lesser' fracture, given the relatively straightforward approach and often formulaic operative tactic. However, it is widely recognised that operative outcomes are not as good as they may be generally thought to be, with in particular, marginal impaction adversely affecting outcomes. Researchers in **Haryana (India)**, recognising that the treatment goal is anatomical reduction and internal fixation (in the longer term attaining painless hip movement and restoring mobility), aimed to

evaluate the long-term radiological and functional outcomes of posterior wall acetabular fractures and identify factors that may contribute adversely to a satisfactory final outcome.⁶ They designed and reported a retrospective study of patients who underwent open reduction and internal fixation (ORIF) of a posterior wall acetabular fracture. Their report consists of a total of 25 patients (20 male and five female) with a single case of bilateral posterior wall fracture. Follow-up was to a mean of nearly 13 years (5 to 22) and Matta's radiographic criteria were used to assess post-operative reduction and final radiological outcomes, with clinical outcomes assessed using the Merle d'Aubigné and Postel scores. Immediate surgical outcomes were excellent, with anatomical reduction achieved in 22 hips, imperfect in four, and poor in 0. By the final reported follow-up, radiological outcome was excellent in ten hips, good in eight, fair in five, and poor in three. Clinical outcomes were similar, with the Merle d'Aubigné and Postel scores reported as excellent in 14 hips, good in six, fair in three, and poor in three. Within this rather small series the authors noted that prognosticators for good outcome included anatomical reduction, while the presence of associated lower extremity injuries and a body mass index (BMI) > 25 adversely affected the final functional outcome. The authors concluded that in patients with posterior wall acetabular fractures, anatomical reduction results in optimal long-term functional and radiological outcomes. However, even in patients with anatomical reduction, the presence of associated lower limb injuries or a BMI > 25 adversely affected final functional outcome. While this is in itself an interesting observation, it really is one of those cases where a larger series of patients is required.

Bugs, plating and resistance [x-ref](#)

■ Early post-operative infection is one of the most difficult complications from both a patient and

surgeon point of view. Although potentially easily treatable, prompt appropriate debridement and antibiotic therapy are usually required for a good outcome. However, the development of an infection is associated with a substantial increase in morbidity and often loss of confidence in the surgeon. Early prompt treatment with suitable antibiotics in combination with surgical debridement can head off at the pass both the infection and loss of confidence. Empirical antibiotic treatment, however, can be difficult as there is a paucity of information in the literature with regards to bacterial speciation and antibiotic sensitivity spectrum, specifically in fracture fixation. Researchers in **Baltimore (USA)** aimed to establish a current evidence base for bacterial speciation and the rates of antibiotic resistance in deep infection following orthopaedic fracture surgery.⁷ The research team included all infections occurring after internal fixation of extremities, pelvis, and acetabulum in their retrospective review of four years of patients at a single institution. The study team identified their patients from CPT and ICD-9 codes which would suggest post-operative infection within 12 months of fracture fixation. Outcomes were assessed including time to presentation, fracture location, bacterial species, and rate of clinically relevant antibiotic resistance. The research team identified 113 infections in closed fractures and 101 in open fractures. Of the infected patients, 36% had at least one type of clinically relevant resistant bacteria. *Staph. aureus* was present in 56% of infections, with 58% of those (32% overall) being methicillin-resistant *Staph. aureus* (MRSA). At least 1 gram negative rod (GNR) was

present in 32% of infections, but only 4% of those were multi-drug resistant. The rate of GNR infections was noted to be significantly higher in infections of the pelvis, acetabulum, and proximal femur (63%) compared with other locations ($p < 0.001$). Although the rate of GNR infections was higher in type III open fractures (35%) compared with type I and II (18%), this was not significant ($p = 0.25$). The authors concluded that at their centre, *Staph. aureus* and GNR deep infections were the most common pathogens seen following internal fracture fixation. In addition, the rate of GNR infections was high but antibiotic resistance in this group was low. This study provides a modern snapshot of post-operative infections following fracture fixation. Given the high rate of GNR infections in the pelvis, acetabulum, and proximal femur, even in closed fractures, the use of aminoglycosides should be considered as part of empirical treatment for early post-operative infections.

Improving outcomes in olecranon tension band wiring x-ref

■ Olecranon fractures are common injuries, and simple fractures without comminution have typically been treated with internal fixation using a tension band wiring technique since the early days of the AO. The tension band principle relies on stable reduction and conversion of tension to compression forces through the figure-of-8 wire construct. The technique remains widely considered to be the gold standard and yields excellent union rates and clinical outcomes. The fly in the ointment, however, is the prominence of metalwork, with up to 80% of patients

requiring a second procedure to remove symptomatic implants. Researchers in **Cardiff (UK)** set out to establish the best orientation of the longitudinal wires to minimise hardware-related failures and specifically surgically modifiable factors contributing to longitudinal wire pullout.⁸ The study team undertook a retrospective review of all olecranon tension band wire procedures performed in their institution. Recordings including pre-operative radiographs were reviewed to classify the fractures and determine operative variables including wire length within the ulna, medullary/cortical position, parallelism of wires, proximal wire prominence, wire angle relative to the ulna, distance from the articular surface, fracture gap, and subsequent pullout. The study team were able to include a total of 182 cases, with a mean age of 52.5 years and a mean radiological follow-up of 7.3 months. With regards to failure by wire pullout, intramedullary wires had a mean pullout of 5.5 mm compared with 2.4 mm for transcortical wires ($p < 0.001$). The authors undertook multiple regression analysis and demonstrated seven independent variables to affect the probability of failure through wire pullout including age, medullary/transcortical wire positioning, bent wires, proximal prominence, ulnar shaft angle, distance from the articular surface, and articular step. The authors conclude that to minimise post-operative wire pullout, the longitudinal wires should be in a transcortical orientation without being bent and, when possible, the wires should be in the immediate subchondral bone (i.e. close to the articular surface). A straightforward paper with a hugely relevant clinical

message. We applaud the authors for a simple but comprehensive paper with an easy to implement clinically relevant message.

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