

ROUNDUP³⁶⁰

Trauma

x-ref For other roundups in this issue that cross-reference with **Trauma** see: *Hip & Pelvis roundup 4; Knee roundup 7; Foot & Ankle roundups 1, 3, 6; Wrist & Hand roundups 3, 7, 9, 10; Shoulder & Elbow roundups 3, 4; Children's orthopaedics roundup 9 and Research roundups 1, 2, 3, 6.*

BMP use increases wound complication rates in trauma surgery **x-ref**

■ Once the preserve of researchers and scientists, synthetic growth factors such as bone morphogenetic proteins (BMPs) are now in common clinical use. They have been thoroughly studied in the pre-clinical and clinical setting and although there is good evidence to suggest that they are efficacious, having been shown to induce bone formation and remodeling, the majority of reports concerning BMP use are predominantly in spinal fusion. Introduction of a BMP into the wound site may not just affect bone formation, and researchers in **Portsmouth (USA)** were particularly keen to examine the potential effects on any wound complications. They designed a study to determine the incidence of wound complications and rates of union associated with the use of rhBMP-2 (Infuse, Medtronic, Memphis, Tennessee, USA) in both acute traumatic and reconstructive extremity cases in a large series of patients. The study team designed a retrospective case-matched series (Level III evidence), including all patients treated in a single level I trauma centre,

between 2002 and 2009. Patients were included where rhBMP-2 was used for acute traumatic injuries or in post-traumatic reconstruction. The study team collated all relevant baseline and demographic data as well as outcomes and wound appearance from a chart review to allow baseline matching between the two groups. Patients were then divided into two groups: Group 1 (case), those treated with rhBMP-2, and Group 2 (matched control), those treated without rhBMP-2. The total cohort consisted of 193 patients treated with rhBMP-2 (38 acute open fractures and 155 reconstructions) and 181 matched patients (36 acute open fractures and 145 reconstructions).¹ There was a statistically significant higher documented rate of wound complications (31%, $n = 60/193$) in the group of patients receiving BMP when compared with the non-BMP group (18%, $n = 33/181$). Factors including age, sex, anatomical site, injury acuity, open fracture, and need for soft-tissue coverage were not correlated with re-operation rates for presumed or actual wound infections. However, the union rate was significantly improved in the rhBMP-2 *versus* the control group (90% vs 74%). When subdivided, union rates were not significantly different in the acute cases (94% vs 79%) but they were in the reconstructive cases (89% vs 73%). The authors concluded that the use of rhBMP-2 in both acute traumatic and reconstructive extremity cases may increase the incidence of wound complications.

Can we predict re-admission in trauma? **x-ref**

■ Re-admission rates are used universally as a measure of healthcare quality, and it is estimated that between 9% and 48% of re-admissions may be avoidable. Understanding the factors associated with re-admission after specific procedures can aid in decision making, patient counseling, and improve the quality of health care. Investigators in **Boston (USA)** set out to establish what factors (if any) can be used to predict the likelihood of re-admission. Using a retrospective cohort of over 3000 patients, the study team aimed to identify the association between re-admission and comorbidities. In addition, they undertook subset analysis to identify the differences in factors associated with all-cause re-admissions and those due to adverse surgical events in patients undergoing operative treatment of skeletal trauma. The investigators undertook a thorough notes review and included a consecutive series of adult patients with isolated or multiple fractures treated operatively at their level 1 trauma centre between January 2008 and December 2011. Comorbidities were recorded and quantified using the updated Charlson Comorbidity Index (CCI). The primary outcomes were hospital re-admission within 30 days of surgery and the subset of re-admissions due to adverse events related directly to surgery. The study team were able to report on an impressive 3452 patients with an average age of 59 ± 21 years. There were 2402 (70%) patients who had internal

or external fixation, 555 (16%) who had arthroplasty and 500 (14%) had other procedures. The mean CCI was 1.7 ± 2.6 points (0 to 19). The investigators report that factors significantly associated with re-admission within 30 days of surgery included higher CCI, older age, and marital status (widowed). The authors used a multivariate logistic regression model for all causes of 30-day re-admission and 30-day re-admission to adjust for any confounders. Their analysis suggested that CCI and older age in both models significantly increased the likelihood of a re-admission. The authors concluded that older patients and patients with greater comorbidities have a higher likelihood of being re-admitted within 30 days of surgery for musculoskeletal trauma, whether from adverse surgical event or any other reason.² Although the statistical model used here clearly associates age and comorbidities with risk of re-admission, there are many other important variations which could not be investigated with a retrospective study. Interestingly, the authors investigated surgery category and type of adverse event but, counterintuitively, these were not predictive. This paper highlights the complexity of re-admission and authors speculate that perhaps future studies can identify potential risk factors not captured in administrative databases, which can then be tracked prospectively.

Humeral bundle nailing **x-ref**

■ Although not reaching the heights of popularity in the UK and mainland USA that it has in Europe, the

Hackethal bundle nailing technique has gained a steadfast following, particularly in continental Europe. The technique involves ‘bunch of flowers’ type nailing, often retrograde. A large number of elastic nails are passed across the fracture site, providing axial and rotational stability due to the ‘bundle’ effect. There is currently much debate surrounding the best treatment of fractures of the proximal humerus. Despite this being the third most common type of fracture in patients aged 65 years and older, currently there is little consensus as to how these common injuries should be best treated. Researchers in **Nancy (France)** have recently published one of the only comparisons of the retrograde ‘bundle nailing’ with the more traditional, antegrade nailing techniques. They aimed to compare the post-operative reduction and stability obtained using the two intramedullary fixation techniques in patients presenting with displaced surgical neck fractures, using a multicentre retrospective comparative study (Level III evidence). Patients included had surgical neck of humerus fractures, either with or without a greater tuberosity fragment. Patients were treated with either a retrograde Hackethal type pinning or antegrade nailing. Outcomes were assessed as fracture stability using plain AP and lateral radiographs taken pre-operatively, immediately after operation, between four and six weeks after operation, and at the latest follow-up. Outcomes assessed included head angulation, translation, and greater tuberosity position. The study population consisted of 105 patients (40 retrograde pinning and 65 antegrade nailing) with an average age of 69 years (18 to 97). There were no differences in the degree of pre-operative fracture displacement between the two groups. A similar post-operative alignment was achieved between the two groups in terms of alignment of AP head angulation (72.5% vs 84%), however, translation was less well controlled in the bundle nailing group (17.5% vs

1.5% residual translation). This was reflected in final follow-up with fracture healing with residual translation in a higher number of the bundle nailing group (19.5% vs 3%). However, there were no visible differences in the greater tuberosity group.³ The authors of this study concluded that in cases of displaced surgical neck fractures of the humerus, with or without greater tuberosity fragment, antegrade nailing provides superior fracture reduction and stability compared with retrograde pinning. Remembering that this paper originates from Nancy, the home of ESIN nailing, this is a surprising result. It is likely that in most other centres in the world results would be considerably poorer than this.

How best to treat high-angle femoral neck fractures? [x-ref](#)

■ The treatment of high Pauwels’ angle neck of femur fractures has been known to be a difficult clinical problem with high rates of failure from fixation. In the older patient this is less important, but younger patients do not do so well with arthroplasty and consequently decision making is more critical. High-angle femoral neck fractures in young adults are relatively uncommon, but when present they pose an important management decision as they can have potentially devastating complications. While many previous efforts have been made to establish the various outcomes from mostly retrospective cohort studies, researchers in **San Antonio (USA)** took a slightly different approach, performing a cross-sectional expert opinion web-based survey of active Orthopaedic Trauma Association (OTA) members. The survey canvassed opinion to determine

implant and imaging preferences in treatment of vertical femoral neck fractures in young adult patients (i.e. 60° Pauwels’ angle in a healthy 30-year-old). Determinants of reasoning for implant selection, evidence base, and routine imaging were also questioned. Data were collected using simple multiple choice questions and/or a 5-point Likert scale. A total of 272 surgeons (47%) responded to the survey.

For a vertical femoral neck fracture in a healthy young adult, the preferred method of fixation was a sliding hip screw with or without an anti-rotation screw (47%), followed by parallel cannulated screws with an off-axis

screw (28%), and parallel cannulated screw construct (15%). When surgeons were asked if their chosen construct “was clearly supported by the literature,” 46% were either unsure or disagreed, while 70% chose their preferred implant because it was “biomechanically most stable”. With regards to imaging, the majority of surgeons required an AP pelvis (70%) and standard hip (88%) radiograph, however, only 29% reported requiring a CT scan, and 59% found a CT scan helpful but not required. In addition, 27% of surgeons changed their implant choice intra-operatively.⁴ As with evidence to support decision making, the authors concluded that a consensus to support the best treatment remains elusive. This study demonstrates the diversity and disagreement among ‘experts’ in determining optimum treatment in this potentially devastating condition and highlights the need for further studies of these fractures which pose a challenging problem with a high rate of treatment failure.



Hyperglycaemia and infection

■ In diabetic patients the relationship between hyperglycaemia and complications including surgical site infections (SSI) has been well documented in the surgical literature. However, this relationship has not been well defined in hyperglycaemic non-diabetic patients outside of the intensive care unit. It is not entirely clear if it is the long-term sequelae of diabetes in conjunction with hyperglycaemia, or glycaemic dysregulation itself (such as that seen with a trauma stress response), that is most closely linked with complications. Researchers in **Nashville (USA)** set out to find out. The research team designed their study to evaluate the relationship between hyperglycaemia and SSI in stable non-diabetic patients with orthopaedic injuries. The authors designed a prospective observational cohort study at a single level I trauma centre over nine months, including patients aged 18 years or above with orthopaedic injuries requiring operative intervention. Patients were excluded from the analysis if they were diabetic, had multisystem injuries, corticosteroid use, or critical illness. The investigators recorded demographics, comorbidity, body mass index (BMI), injury and operative details. Hyperglycaemia was defined as a fasting glucose value of ≥ 125 mg/dl or a random value ≥ 200 mg/dl and finger prick glucose values were obtained twice daily. If patients recorded a hyperglycaemic reading then glycosylated haemoglobin levels were obtained. Surgical site infection (SSI) was defined with stringent criteria of a positive intra-operative culture at re-operation within 30 days of index procedure. A total of 171 patients were enrolled, of whom 40 (23.4%) were hyperglycaemic and seven of them were excluded for occult diabetes. Of the remaining 164 patients, 33 were hyperglycaemic (20.1%), 50 had open fractures (six Type I, 22 Type II, and 22 Type III), and 12 (7.3%) had

a SSI. Hyperglycaemic patients were significantly more likely to develop SSI (7 of 33 (21.2%) vs 5 of 131 (3.8%), $p = 0.003$). Additionally, open fractures were associated with SSI (7 of 50 (14%) vs 5 of 114 (4.4%), $p = 0.047$), but not hyperglycaemia (10 of 50 (20.0%) vs 23 of 114 (20.2%), $p = 0.98$). There were no significant differences in other measured demographic factors between infected and non-infected patients.⁵ The authors concluded that stress hyperglycaemia in stable non-diabetic patients with orthopaedic injuries was associated with SSI. This study suggests that recognition of the association between hyperglycaemia and infectious complications may significantly influence post-operative outcomes in orthopaedic patients. The difficulty is of course in defining an intervention to modulate incidental hyperglycaemia in the non-critically ill trauma population.

Simultaneous soft-tissue and bony repair in terrible triad injuries [x-ref](#)

■ The so-called 'terrible triad' injury results from a circumferential loss of joint stability in the elbow with disruption of bony and soft-tissue elements. The original terrible triad injury described a coronoid process, medial collateral ligament injury and radial head fracture, resulting in loss of restraint to valgus and rotatory forces. Various refinements of the definition have included posterior-lateral instability and other combinations, all resulting in severe instability. Researchers in [Shanghai \(China\)](#) have revisited the outcomes of terrible triad injuries with a newer modified technique. While the surgical tactic itself isn't different from that undertaken by the majority of surgeons (a combined radial head reconstruction with soft-tissue repair), surgeons differ in their views on a two-incision (antero-medial and direct lateral approach as used here) *versus* a direct posterior approach. For a relatively rare injury, the authors did well to

assemble a cohort of 21 patients, all of whom had a terrible triad injury fixed through a stepwise approach. The surgical technique included reconstruction or replacement of the radial head along with direct repair of the coronoid, if required through an antero-medial approach with repair of the medial collateral ligament and medial structures as required. Unfortunately, this was a retrospective review and outcome data were only collated retrospectively, making this a level IV evidence paper. The outcomes were assessed clinically (Mayo elbow score) and the Broberg and Morrey classification was used for subsequent radiological evaluation of traumatic arthritis. Patient outcomes were assessed at a mean of 32 months (24 to 48) and patients achieved a flexion arc of 126° and a mean forearm rotation of 139° . Clinical outcomes were assessed as excellent in most instances ($n = 19/21$), with a mean Mayo score of 95 points. Concentric stability was restored in all cases although there were a number of complications, with nearly 25% of patients suffering a complication (two heterotopic ossification, one radial head non-union, one infection and one ulnar nerve palsy).⁶ While we would not completely agree with the authors that their operative intervention is 'unique' in providing bony and soft-tissue stability, we would agree that the results of this and similar strategies appear far better than the older series reporting simply bony reconstruction.

Metaphyseal malunion in the forearm leads to function restrictions [x-ref](#)

■ Despite the staggering numbers of presentations of children with both bone forearm fractures, surprisingly little is yet known about the predictors of outcome. It is a commonly held belief that limitation in pronosupination is caused by angular deformity following a malunion of both bone forearm fractures. We were as surprised as authors in [Rotterdam \(The Netherlands\)](#)

to find that although it underpins much of paediatric trauma practice, there is no evidence basis for this in the literature. The study team therefore sought to find out if limitation of pronosupination is indeed caused by angular malalignment of the forearm. They designed a prospective prognostic study (Level I evidence) to test the hypothesis that limitation of pronosupination could in fact be predicted by angular deformity of the forearm bones. The authors collated outcome data on children presenting to four Dutch hospitals over a four-year period. Children were all aged under sixteen and followed for at least six months following their fracture. Outcomes were assessed at final follow-up when angular deformity and restriction in pronosupination were measured. Of the study population of patients, complete outcome data were available on 393 with a mean age of eight years. The majority were male (63%) and had fractured their non-dominant arm (60%). Follow-up was for a mean of 219 days. The major message of the study was that in children with metaphyseal injuries with less than 15° of angulation, restriction in functional forearm rotation is extremely unlikely (just 13%) whilst angulation of $> 15^\circ$ results in a 60% chance of restricted movement. Interestingly the picture was different in the diaphysis. Children with angular deformities of $> 5^\circ$ had a 13% chance of developing a significant functional restriction, but this did not rise with increasing deformity.⁷ This is an extremely well executed paper, which has a simple and clinically relevant message; well worth a read and inward digestion by all involved in paediatric fracture management.

Delayed fixation of the distal radius: not a bad option [x-ref](#)

■ Knowing when to intervene in the distal radius can be a tricky business, and for clinicians favouring a more conservative approach (which occasionally results in a late slip) or patients presenting late with

an unfavourable position, there is an increasing trend towards using a volar fixed angle device used without either extended approaches or synchronous dorsal osteotomies. Surgeons in [Jerusalem \(Israel\)](#) set out to establish some form of evidence for this practice which, as they rightly point out in their introduction, has crept into common practice without recourse to an evidence base. The study team devised a comparison series of patients presenting late with fractures of the distal radius (arbitrarily defined as 21 days) and those undergoing acute fixation. Their retrospective comparative series (Level III evidence) encompassed the outcomes of 105 patients undergoing distal radial fracture fixation (40 late and 75 age-matched controls). Surgery was undertaken in an identical manner for all patients and a volar approach with brachioradialis release was used. In no cases was a formal osteotomy performed, and the same fixed angle volar plate (DVR plate) was used in all cases. Outcomes were assessed at a mean of 3.4 years using clinical outcome scores (QuickDASH and SF-12 scores) and radiological measures (volar tilt, radial inclination and radial length). There was a significant difference in QuickDASH score between the two groups (27.1 in delayed group vs 6.3 in the control group). The authors comment that if two cases with complications are excluded, this difference is non-significant. The authors found no differences between radiological parameters in the two groups.⁸ While the authors conclude that based on their data surgery was associated with "predictable, favourable results", we would not completely agree. Selective exclusion of cases (even if they are ones with complications) is not acceptable and is tantamount to bias. What it is possible to say is that radiological parameters are similar and that although outcomes are subject to more adverse events in the delayed fixation group, if complications do not occur there are no differences in outcome.

Fasciotomies better with shoelaces

■ These days it seems that there is no wound too big, too small, too open or too closed for application of a VAC dressing. Surgeons across all disciplines are applying them to diverse wounds ranging from open abdomens to closed fasciotomies. One big recent trend is the use of the VAC on fasciotomies; at face value, perhaps the best indication for a VAC. Management of swelling, oedema and tissue fluid are all potential problems and the system is used in many places now in preference to the traditional 'shoelace' technique. Researchers in **Alexandroupolis (Greece)** set up a randomised controlled trial to establish the efficacy of VAC treatment when compared with traditional shoelacing in the management of fasciotomy wounds. Although reported as consisting of '82' wounds, in fact the study

reports 25 patients in each group with the use of the selected skin closure technique on each skin wound. Curiously, some patients had a single-incision and some a double-incision fasciotomy (likely to bias results and an unusual treatment variation in a well conducted randomised controlled trial). Outcomes were assessed based on time to wound closure, complication rates, need for additional interventions and daily treatment costs. The investigators report that in their study, wound closure times were higher in the VAC group (by around three days) although there does appear to be a failure of randomisation with a higher rate of late fasciotomies in the VAC group which are associated with longer wound closure times and higher rates of complications.⁹ This paper supports the shoelace technique for closure of fasciotomies with no returns to theatre and a quicker

closure rate in the fasciotomy group. The drawbacks of this study (small numbers, heterogeneous interventions and uneven groups) mean this should be taken with a pinch of salt, and when combined with the lack of a power calculation this study should be viewed more as a pilot.

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