ROUNDUP360

Trauma

For other Roundups in this issue that cross-reference with Trauma see: *Hip Roundups 2 and 4; Foot & Ankle Roundup 1; Wrist & Hand Roundup 2; Shoulder & Elbow Roundup 2; and Children's orthopaedics Roundups 2 and 3.*

Radiological, electromagnetic or just leave it out altogether?: distal locking in intramedullary nailing

■ In a bumper crop of comparison articles examining the whys and wherefores of long bone interlocking screw insertion, the *Journal of Orthopaedic Trauma* has examined the trend for interlocking screw placement using electromagnetic localisation. The system works through the use of a generated electromagnetic field and then the use of a computer to detect the inductance effect in a sensor, in this case used as a drill guide. There is no radiation associated with the technique but it does require a clumsy drill guide and yet another set of equipment in theatre. Opinion here at *360* is very much divided as to the benefit.

■ Researchers from **Tampa (USA)** designed a simple study to assess the potential benefit of such a system. They designed a comparative cohort study (Level III evidence) and although the patients were not formally randomised the use of the new electromagnetic (EM) technique was based purely on the availability of the instrumentation. The investigators noted the time taken (including technician delay time), x-ray exposure and 'screw insertion time' as their end points. During the study period 101 distal interlocking screws were inserted (60 with the FL technique and 41 with the EM technique). The technique was 100% accurate in both groups and the researchers identified a statistically significant difference in screw insertion time (342 *versus* 228 seconds) in favour of the EM technique. Interestingly, there was no difference in set up time (it appears an experienced radiographer can obtain 'perfect circles' as quickly as the EM machine). The authors conclude that the EM technique has the advantage of a significantly quicker insertion time (nearly two minutes quicker) and the benefit of no radiation exposure.[1] While we would agree with the latter, the former is potentially up for a little debate. The authors do not include the time taken to obtain a check fluoroscopy image in their insertion estimate for the EM technique. If they had done so (and if the times taken were similar), the difference between the two techniques would be less than a minute, and not statistically (or indeed clinically) significant.

■ A similar study, this time from investigators in **New York (USA)**, used slightly more complex methodology (in this case a randomised controlled trial) to establish the benefit or otherwise of the EM interlocking system. The study team designed a trial establishing the use of the EM system in femoral and tibial antegrade diaphyseal nailing. The study team selected outcome measures of the time to perfect circles and time from drill initiation to completion of interlock. In a well designed study the researchers randomised patients to either standard FL guided interlock or EM guided interlock. Fifty five patients were recruited to the study, of whom 48 fractures (in 47 patients) were successfully randomised and completed the study. The primary outcome measures of time to perfect circles (1:22 *versus* 2:51 minutes) and time to screw placement (3:44 *versus* 5:12 minutes) were both also in favour of the EM device. There were, however, three failures of the EM device when traditional FL targeting had to be used and the benefit of the EM method was found to be greater with the more junior residents. Again the study design did not include the time required to obtain a successful post-interlocking fluoroscopy image – which again may have seriously affected the results.[2] During the 16-month time period, 171 long bone nailing procedures were performed at the originating centre, and just one in four patients were recruited into the study, raising the chances of a significant selection bias. That said, the message does seem fairly clear. Taken together, these studies show that around three minutes can be saved with the use of the distal interlocking EM device. Assuming the kit set up time and additional check image required takes less than those three minutes, you may even save time for an extra cup of coffee between cases. For trainee surgeons and those who struggle with interlocking, we are sure this device will find a really useful home, however, it seems to us here at *360* there may be a certain level of 'gimmick' attached.

■ In a completely counter article, a research team in **Brooklyn (USA)** ask the question, 'is distal locking necessary at all for certain fracture types?'. Distal locking of intermedullary nails provides rotational and axial stability; this is clearly important in diaphyseal fractures and unstable fracture configurations. However, with more anatomically shaped nails (anterior femoral bowed nails have some intrinsic rotational stability) or certain fracture configurations (intertrochanteric fractures), rotational and axial stability may not need to be conferred by interlocking. In an interesting cadaveric femoral study, the research team used 11 paired cadaveric femora and undertook a randomised controlled trial to establish the value of the distal interlock in a standardised model of a four-part femoral fracture. The research team undertook a comprehensive analysis of resistance to torque. Femora were randomised to distally locked or unlocked fixation although the distally locked nails had a higher rotational torque to failure (57.9 Nm *versus* 29.1) and a higher rotational stiffness (119.4 N m/rad *versus* 77.2 N m/rad). Despite these significant differences in resistance to torsion both were well above physiological loads, so quite sensibly the authors conclude a distal interlock is probably not required.[3] More and more journals are running companion articles in the same issues, or articles with invited

commentaries and it is a trend we hope here at *360* goes from strength to strength. There is so much more added value in paired (or even, as in this case, tripled) articles than in a single point of view.

Internal fixation of radiation-induced pathological fractures of the femur has a high rate of failure

Treatment of radiation-induced pathological fractures is a particularly tricky area of traumatology. Patients who have received high doses of localised radiation have poor wound healing, high infection rates and often areas of dead and necrotic bone. Despite a widely held belief that the outcomes of fixation are poor with high rates of nonunion and implant failure, there is surprisingly little scientific literature on the subject. Researchers from **Toronto (Canada)** aimed to plug the evidence gap and report the outcomes of a surprisingly large series of patients. Using their tumour database, the research team were able to identify 22 patients who underwent excision of a soft-tissue sarcoma followed by adjuvant radiotherapy and who suffered a subsequent pathological fracture of the femur. The research team collated demographic data about the patient, tumour, fracture and fixation, paying particular attention to complications including nonunion and infection. Patients included in the series had a mean age of nearly 60 years (39 to 86) suffering radiation-induced fractures between two months and over 16 years following radiotherapy. The research team were able to report the results of surgery with over five years of average follow-up. The complication rate was extremely high, with 86% of patients suffering one or more complications, including an over 80% incidence of nonunion by one year follow-up. Of those 18 patients suffering nonunion, 11 were radiological, five were complicated by metalwork failure and two by infection. A single patient suffered a subsequent second radiation-associated fracture. Of the original 22 patients, 13 (59%) underwent revision surgery of some variety, requiring 24 revision operations.[4] It is often difficult to quantify the risk of surgery in rare conditions (such as this) and these sorts of case series are invaluable for informing patients and surgeons of the risks. In the case of post-radiation-associated fracture this would suggest to us here at *360* that given the amazingly high complication and revision surgery rates, these fractures should be treated in a regional centre by specialist trauma surgeons.

Obesity and trauma

There is plenty of evidence that, particularly in road traffic accidents, obesity affects the patterns of presentation of trauma patients, with different injury patterns. There is even talk of smart car seats that will weigh the patient and activate safety systems modified according to the patient's weight. Obese patients have more protective fat but behave differently in impacts, with more inertia, and are more difficult to effectively restrain with safety belts. It isn't just the pattern of injury that has the potential to differ in obese patients; these patients have different physiology. As more is being understood about the physiology of the trauma response and how important the physiology of trauma is to optimising outcomes, the next natural question is, 'does obesity (and other metabolic abnormalities) affect a patient's ability to overcome trauma?'. A review team in **Wuhan (China)**, a country not renowned for its levels of obesity, conducted a systematic review to establish what is currently known about the effect obesity has on injury severity, mortality and patients post-trauma care. The study team used a systematic review and meta-analysis study design, and statistical analysis, including the use of a random effects model to compare outcomes between obese (BMI > 30 kg/m^2) and non-obese patients. There were 18 studies reported in the literature, reporting outcomes on over 45 000 patients (7751 of whom were obese). While the injuries sustained between the two groups were apparently no different in severity, there were marked differences in outcomes. Obesity was associated with an increased risk of death, longer ICU stays, increased periods of ventilation, longer hospital stays, and higher rates of complications. The results seem conclusive on the surface, but they are potentially subject to a significant selection bias. If the patterns of injury in obese patients are indeed different, on the surface simple case series may be suitable for comparison, however, if the mechanisms of injury differ, there may be a profound, but not initially obvious, selection bias.[5] The review authors conclude that the current evidence strongly supports the hypothesis that obesity is in itself a risk factor for poor outcomes following traumatic injury. As more is understood about the stress response and the effects of major injury, it may be possible to tailor treatment and resuscitative goals to a patient's individual physiology.

Short and sweet?: antibiotics in open fractures

In a highly topical adjunct to our feature on open fracture and blast injury this month, researchers from **Geneva (Switzerland)** have asked what clinical variables are associated with infection in open fractures. They have reviewed a retrospective case series (Level IV evidence) of nearly 1500 patients with open fractures. The majority of these were grade I (44.4%), with smaller numbers of grade II (24.8%) and grade III (20.8%) injuries. Puzzlingly, the authors report 'unclassifiable' injuries in 149 patients, which is potentially reflective of the quality of record keeping and certainly makes us suspicious of any conclusions drawn on these data here at *360* HQ. The event rate of infection was extremely low with 54 infections (3.6%), which is likely representative of the high numbers of low grade injuries included in this series. Antibiotics were given for a median of three days post-operatively. The causative organism was known in 49 cases, of which 35 were resistant organisms (predominantly Enterococci and Enterobacter). The authors undertook a multivariant analysis, and factors predictive of infection were grade III fractures, compartment syndrome and vascular injuries. The authors were not able to identify any difference in infection risk between patients treated prophylactically with antibiotics for a single day, two to three days (OR 0.6), four to five days (OR 1.2) or more than five days (OR 1.4). The analysis was repeated for patients with just grade III injuries and a similar picture was seen. The authors venture that even for grade III injuries a single day of antibiotics may be sufficient.[6] While we wouldn't disagree with the findings of this study, it is often easy to be blinded by complex statistics and simply accept study findings on face value. There is no evidence presented here that longer courses of antibiotics are associated with a lower rate of infection. However, this is likely to be underpowered (there were only 54 infections spread across multiple GA grades and antibiotic regimes), making the raw number of events in each subgroup incredibly low. Added to this is the retrospective nature of the study, with some patients selected for longer antibiotic regimes at the clinician's discretion (presumably those with more significant injuries) which may add further

confounding effects. This is a question where a randomised controlled trial is really the only way to be sure. We found this an interesting, but not game-changing, paper for us here at 360. We will continue in our current practice of following the nationally agreed guidelines.

Extremity injuries more important than previously thought?

The big killers in the multiply injured patient are all causes of haemorrhage, with thoracic, head and pelvic injuries the most common sites of life-threatening haemorrhage. However, there are some accumulating data that extremity injuries may be independent predictors of mortality in the severely injured. A research team in **Cologne (Germany)** set out to test the hypothesis that distinct extremity injuries are associated with a poorer prognosis following major injuries. They used the German trauma registry (which has been keeping data on patients since 1993) to establish if this is indeed the case. Using a modern dataset of patients admitted over a seven-year period between 2002 and 2009, all patients over the age of 16 years with an ISS > 16, a group of 24 885 patients, were identified. These were divided into two separate cohorts based on the presence of a significant extremity injury (AIS ≥ 2). The study was designed to document the incidence, epidemiology and impact of extremity injuries in multiply injured trauma patients. Nearly 60% of the 24 885 had a documented significant extremity injury, with an average of 2.1 fractures per case. The most common injury patterns were femoral fractures (16.5%), tibial fractures (12.6%) and clavicular fractures. As would be expected, patients without an extremity fracture had a lower GCS at the scene, with higher 30-day mortalities associated with more severe brain injuries. However, patients with extremity injuries suffered higher rates of chest trauma, transfusion, operative procedures and longer ICU stays.[7] The authors conclude that there are two distinct groups of trauma patients, those with limb injuries who suffer higher rates of complications and multisystem injury, and those without who have a higher rate of mortality associated with more severe head injuries.

Cement nails tiptop for osteomyelitis

The practice of using antibiotic-loaded cement nails for sustained local antibiotic elution in cases of endosteal osteomyelitis is widely publicised, but there are few medium- or long-term results. We were delighted to read this report from surgeons in **Otwock (Poland)** describing their experience with the use of a home-made reinforced cement nail in a prospective case series of ten patients (Level III evidence). All of their cases had developed infection following intramedullary tibial nailing. All ten patients underwent an identical treatment regime of removal of their initial fixation, endosteal reaming and implantation of a home-made antibiotic cement nail. Patients were treated with the nail in situ for six weeks and underwent cement nail extraction and definitive fixation at the six-week time point. The Polish surgeons are able to report the longest follow-up for this kind of fixation of six years, and in all cases they were able to eradicate the bony infection and establish union. However, the authors report high rates of additional procedures. Each patient underwent an average of four additional surgeries including flaps, bone grafting and cosmetic procedures.[8] This series of patients demonstrates how effective an intramedullary antibiotic nail can be. While patients continue to represent a complex surgical challenge, the use of antibiotic-loaded nails is an effective method for treating established infection.

Oxygen measurements for compartment syndrome?

Intervention in compartment syndrome and the indications for measurement of compartment pressures is an intervention fraught with difficult decision making. While diagnosing established compartment syndrome is relatively easy, the clinical challenge is in the diagnosis and operative release of evolving compartment syndrome. There are proponents, most notably the Edinburgh group, of continuous compartment pressure-monitoring regimes, but there is mixed evidence to support this practice and consequently few units routinely use compartment pressure monitoring in the awake patient. The pathophysiology of compartment syndrome is one of an increased pressure leading to a cycle of hypoxia resulting in inflammation, tissue death and localised acidosis. Much recent attention has focused on the possibility of measuring the peripheral tissue oxygen saturations as a marker of evolving compartment syndrome. However, to date there is little clinical data to support this approach. Researchers in **San Francisco (USA)** have investigated the role of direct intramuscular tissue oxygenation (PmO_2) to detect localised ischaemia in patients at risk of extremity compartment syndrome. The investigators present this small exploratory study of ten patients treated for extremity compartment syndrome following intramedullary nailing of their isolated tibial fracture. The researchers measured both compartment pressures and PmO_2 with percutaneous probes in the anterior compartment of the leg during the 48-hour post-operative period. Patients were considered at high risk of compartment syndrome if pressure readings of PmO_2 < 10 mmHg, CP > 30 mmHg and perfusion pressure ΔP < 30 mmHg were measured. None of the ten patients had any clinical signs of compartment syndrome. The compartment pressure monitoring system demonstrated a high false positive rate with readings of CP > 30 mmHg in over 50% of readings and ΔP < 30 mmHg in around one third (31.01%) of cases. By contrast, the PmO_2 was only positive in less than 1% of readings.[9] This study is too small to make a meaningful comparison of the two methods, with no patients developing compartment syndrome, however, it does allow for an analysis of the false positive rate which is markedly lower with the PmO_2 method. This does look to represent a good avenue for potential future research into early detection of compartment syndrome. It does seem likely that, as a central part of the compartment syndrome mechanism, reliably establishing a test for the early signs and symptoms will ease diagnosis in future.

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