plate fixation. The study team were able to include a total of 15 studies (12 observational and three randomized controlled trials) in their review. These trials reported the outcomes of 893 patients overall. The bottom line from this study is that overall, ACDF with plate fixation was associated with significantly higher vertebral fusion rates (odds ratio (OR) 1.98), lower subsidence rates (OR 0.31), and more favourable visual analogue scale (VAS)-neck pain scores (mean difference 0.59) at last follow-up. On the flipside, ACDF without use of an anterior fusion plate had better long-term VAS arm pain scores (marginal mean difference 0.2). Perhaps most importantly, the authors found no differences in the rates of dysphagia (OR 1.21, 95% confidence interval 0.57 to 2.56). Overall, this meta-analysis, although based on limited data, supports the use of plates to achieve a more stable fixation with less subsidence and a higher fusion rate without the feared increase in dysphagia rates.

REFERENCES

1. Nunez-Pereira S, Vila-Casademunt A, Domingo-Sabat M, et al. Impact of early unanticipated revision surgery on health-related quality of life after adult spinal deformity surgery. *Spine J* 2018;18:926-934.

2. Safaee MM, Deviren V, Dalle Ore C, et al. Ligament augmentation for prevention of proximal junctional kyphosis and proximal junctional failure in adult spinal deformity. *J Neurosurg Spine* 2018;28:512-519.

3. Kelly MP, Eliasberg CD, Riley MS, Ajiboye RM, Soohoo NF. Reoperation and complications after anterior cervical discectomy and fusion and cervical disc arthroplasty: a study of 52,395 cases. *Eur Spine J* 2018;27:1432-1439.

4. Thomé C, Klassen PD, Bouma GJ, et al. Annular closure in lumbar microdiscectomy for prevention of reherniation: a randomized clinical trial. *Spine J* 2018 (Epub ahead of print). PMID: 29730458

5. Külling FA, Ebneter L, Rempfler GS, Zdravkovic V. A new parallel closing mechanism for the laminectomy rongeur makes it significantly more precise: a biomechanical and mechanical comparison study. *Eur Spine J* 2018;27:1172-1177.

6. Pasha S, Flynn JM, Sankar WN. Outcomes of selective thoracic fusion for Lenke 1 adolescent idiopathic scoliosis: predictors of success from the sagittal plane. *Eur Spine J* 2018. (Epub ahead of print). PMID: 29564609

7. Oliver JD, Goncalves S, Kerezoudis P, et al. Comparison of outcomes for anterior cervical discectomy and fusion with and without anterior plate fixation: a systematic review and meta-analysis. *Spine* 2018;43:E413-E422.

Trauma

X-ref ***For other Roundups in this issue that cross-reference with Trauma see: Foot & Ankle Roundup 1; Shoulder & Elbow Roundups 1 & 2; Children's orthopaedics Roundup 6; Research Roundup 7.***

Periprosthetic femoral fracture *versus* native hip fractures

Thankfully, periprosthetic fractures following total hip arthroplasty (THA) are relatively uncommon, being reported to complicate between 0.1% and 4% of patients during the lifetime of their prosthesis. However, with increasing numbers of arthroplasties being performed, and an ageing population, the number of these fractures can be expected to increase. Much has been written on the outcomes following native hip fractures, particularly in terms of mortality, but much less is known about the mortality following periprosthetic fractures of the hip. The authors of this study from **New York, New York (USA)** set out to evaluate the mortality of periprosthetic hip fractures, comparing them to native femoral neck and intertrochanteric hip fractures over a nine-year period.[1] This report is based on a database query of 1655 patients, all with a periprosthetic fracture of the proximal femur. Patients had a mean age of 78.9 years. A comparative group of 97 231 patients with a native hip fracture had a mean age of 82.6 years. Patients with a periprosthetic fracture had a lower mean comorbidity score and also had longer surgical delays. At the traditional 30 days following injury, the mortality rate for patients with a periprosthetic fracture was 3.2%, compared with 4.6% for those with a native hip fracture. Adjusting for possible confounding factors, there was no difference between the two groups for risk of death at one month. At six months, the mortality rate for those patients in the periprosthetic group was 3.8%, compared with 6.5% for those native hip fracture group. Adjusting for confounding factors, the risk of death remained lower in the periprosthetic group compared with the native hip fracture group. These differences in mortality became even more marked at one year (9.7% *vs* 15.9%) in the native hip fracture group. The risk of death was 29% lower for the periprosthetic fracture group compared with the native hip fracture group. The authors also identified factors that increased the mortality risk. In the native hip fracture group, advanced age, male gender, being Caucasian, higher comorbidity scores, and surgical delay were all associated with increased mortality risk. Those patients in the periprosthetic fracture group saw an increased risk in mortality if they were aged 80 years and over, were of male gender, and had higher comorbidity scores. Interestingly, there were no significant associations with surgical delay in this patient group. The authors did find that there was an increased risk of mortality associated with revision arthroplasty for periprosthetic fracture, as opposed to open reduction and internal fixation. This study was interesting for several reasons. First, it identified that the mortality risk is similar for both groups in the acute period following the injury, but, over the longer term, those in the periprosthetic group fared better. This is one of the largest studies of this kind published to date and involves patients from multiple institutions, enabling the authors to exclude a number of important potential biases. The difference in mortality risk for those patients who had fixation as opposed to replacement for their prosthetic fracture is not too surprising. Revision hip arthroplasty involves a greater physiological insult, with longer operative time and higher blood loss. This study also suggests that surgical delay was not a risk factor for increased mortality in the periprosthetic group, unlike the widely accepted (but yet to be proven) view in those patients with native hip fractures. Previous studies have confirmed that surgical delay in patients with native hip fractures is associated with a worse prognosis. Perhaps the periprosthetic hip fractures group have fewer significant comorbidities? What is clear is that the incidence of periprosthetic hip fractures is likely to increase, and that all institutions need a standardized pathway to manage these high-risk patients with multidisciplinary involvement, including physicians and surgeons with the necessary expertise.

Factors associated with revision surgery after internal fixation of hip fractures **X-ref**

One of the largest trials in trauma recently is the Fixation using

Alternative Implants for the Treatment of Hip fractures (FAITH) trial. The trial reported the outcomes of 1108 patients who were randomized to either a sliding hip screw (SHS) (n = 557) or multiple cancellous screws (MCS) (n = 551). The outcomes initially reported were reoperations within 24 months. There were no differences in the primary outcomes, with 107 (20%) of 542 patients in the SHS group *versus* 117 (22%) of 537 patients in the cancellous screws group, although the authors established that avascular necrosis was more common in the sliding hip screw group (50.9% *vs* 28.5%). This month, the authors of that major piece of work, from **Hamilton (Canada)**, have reported further research attempting to establish what exactly determines healing.[2] Investigators did a secondary analysis of data collected as part of the initial FAITH Trial. The study was designed to evaluate associations between baseline and surgical factors and the need for revision surgery to promote healing, relieve pain, treat infection, or improve function over 24 months postoperatively. Looking back at the data set, the investigators were able to find five factors that were significantly associated with increased risk of revision surgery: female sex (hazard ratio (HR) 1.79); higher body mass index, for every 5-point increase (HR 1.19); unacceptable quality of implant placement (HR 2.70); smokers treated with cancellous screws *versus* smokers treated with a sliding hip screw (HR 2.94); and younger age, which was associated with a higher risk for metalwork removal. For every ten-year decrease in age, participants experienced an average increased risk of 39% for metalwork removal. The results of this analysis may help guide treatment decisions in patients with femoral neck fractures by identifying high-risk patients who may be better treated with arthroplasty as opposed to internal fixation.

Surgical timing 30-day mortality in adults undergoing hip fracture surgery

On the face of it, patients who are delayed for their hip fracture surgery are likely to be at a greater risk of complications and are more likely to suffer those complications through delay to surgery. Any prolonged period of bed rest, supine, would appear to increase frailty, and the subsequent increased risk of anaesthesia would clearly increase the risk of death. However, despite many studies examining the potential association, there is still no clear-cut answer one way or the other. The investigators in the current study aimed to perform a population-based, retrospective cohort study of 42 230 adults (mean age, 80.1 years) undergoing hip fracture surgery over a five-year period at 72 hospitals in **Toronto (Canada)**.[3] The authors undertook a relatively advanced analysis using risk-adjusted restricted cubic splines to model the probability of each complication according to wait-time. The inflection point (in hours) when complications began to increase was used to define early and delayed surgery. Their main outcomes measure was mortality within 30 days. Secondary outcomes included a composite of mortality or other medical complications (myocardial infarction, deep vein thrombosis, pulmonary embolism, and pneumonia). The authors established that the risk of complications increased significantly when wait times were greater than 24 hours, irrespective of the complication considered. Compared with 13 731 propensity-score-matched patients who received earlier surgery, the 13 731 patients who received surgery after 24 hours had a significantly higher risk of 30-day mortality (6.5% *vs* 5.8%) and the composite complications outcome (12.2% *vs* 10.1%). The authors concluded that a wait time of 24 hours for hip fracture surgery may represent a threshold-defining higher risk. Whilst this is a straightforward database trawl study, it is powerful enough to quantify what has always been suspected: an excess complication rate following delay to surgery. The authors' use of a composite complication outcome and a cubic splines method allows complex non-linear associations to be defined. Rather than simply selecting an arbitrary cut-off for comparing early *versus* late complications, the authors were able to accurately establish the best threshold by determining the point at which the complications rates are likely to rise from surgical delay.

WOLLF for lower-limb open fractures

The Wound Management of Open Lower Limb Fractures (WOLLF) study, one of the most hotly anticipated trials in trauma, has recently been published in *JAMA*.[4] The authors designed a large pragmatic randomized controlled trial comparing dressing types in open lower-limb (chiefly tibial and femoral) fractures that were not suitable for primary closure. A total of 460 patients with grade III open lower-limb fractures, aged over 16 years, were recruited across the UK Major Trauma network over a three-year period. Patients were all treated within 72 hours of fracture and did not undergo primary closure, so, as such, they had a dressing applied prior to delayed flap closure or delayed primary closure. The pragmatic nature of the trial was such that patients randomized to the intervention group were treated with a vacuum-assisted dressing (VAC) of any variety, and the control group had a standard dressing (including bead pouch and all other types of non-vacuum dressings). Outcomes were assessed in terms of limb function (disability rating index) and health-related quality of life (using the Euro-Qol 5D (EQ-5D) and health-economic analysis). The study team recruited 226 patients to the VAC group and 234 patients to the standard dressing group. The bottom line result was that there were no differences in any of the primary outcome measures at 12 months. However, perhaps more surprising was the finding that there were no differences in the numbers of deep surgical site infections: 7.1% (n = 16) in the VAC *versus* 8.1% (n = 19) in the standard dressing group. From the quality-of-life perspective, which would also be expected to be different if there were a difference in secondary complications, there was a barely detectable difference of 0.02 points on the EQ-5D between the two groups. This is the largest randomized trial reported in open lower-limb fractures to test different dressings. It looks, somewhat counterintuitively, like the VAC dressings do not improve self-rated disability at 12 months.

Dosage of prophylactic antibiotics and open fractures

There is, unusually, almost universal agreement within the orthopaedic trauma fraternity that the best and most important treatment for open fractures is antibiotic prophylaxis on admission. Most systems are centred on early administration of antibiotics to minimize later infection. These protocols, however, focus on a fixed dose of antibiotics, whatever the size and weight of the patient. We were interested, here at *360*, to read this simple but insightful report from **Memphis, Tennessee (USA)**, in which the authors aimed to establish how often use of standard protocol results in the administration of a dose of antibiotics that is too low, and to try to establish if this has an effect on eventual infection rates.[5] The authors evaluated infection rates at one year in 63 patients with open tibial fractures (Gustilo–Anderson type IIIA or IIIB) presenting open extra-articular tibial fractures to a single centre over a five-year period. The infection rate was high, as expected, with 33% (n = 20) of patients developing infection by the one-year follow-up point. The most startling observation was

that, of the 20 patients who went on to develop a deep infection, around half of the patients had an appropriate dose of antibiotics. Of those who did not develop a deep infection, around three quarters had received the correct dose of antibiotics. This difference was significant and clearly suggests, although it is not entirely causally proven, that underdosing of intravenous antibiotics may be in part to blame. This suggestion is further underlined by the observation that, in this patient series, there was a higher incidence of cefazolin-sensitive infections in those that were underdosed. It is an easy win to introduce a weight-based dosing regimen in those antibiotics that require it, and the suggestion here is that this will reduce the incidence of antibiotic resistance. The caveat to this, of course, is that there may well be an association with being overweight, comorbidity, and susceptibility to infection.

Competency in hip hemiarthroplasty X-ref

■ Hip hemiarthroplasty is the proving ground for pretty much every junior orthopaedic surgeon the world over, alongside other 'simple' operations, such as ankle fracture fixation. With the recent spotlight on the issues associated with volume and outcomes in a range of arthroplasties, it was only a matter of time until the question was raised about complications and volume in hip arthroplasty. Whilst this paper from **San Diego, California (USA)** is worthwhile, in that it starts the ball rolling, we were somewhat disappointed with the bar of one hemiarthroplasty per year that the authors set.[6] The authors included all patients within the state of New York who underwent a hip hemiarthroplasty following fracture over a 14-year period. The authors queried the statewide healthcare coding data set and extracted demographic and injury information about patients who required a hip hemiarthroplasty. The authors then undertook analysis on a per-surgeon and per-hospital basis stratified by volume, and adjusted for Cox proportional hazards regression, taking clinical and demographic factors into account. Overall, the authors included 58 814 patients. The authors defined low surgeon volume as performance of one case per year, and compared them with surgeons performing two or more cases per year. Hospitals were dichotomized into low (< 20 cases) and high volume (20+) cases per year. As perhaps would be expected, there were higher rates of complications in the low-volume surgeons and units. This effect was seen from the hospital perspective in terms of overall complication rate (hazard ratio (HR) 1.11), deep infections (HR 1.39), and medical complications. The surgeon incidence of complications was also higher in the lower-volume group, with the study finding increased overall complications (HR 1.35), dislocations (HR 1.31), and medical complications. Perhaps one of the more interesting findings, however, was that volume was not associated with reoperation or inpatient mortality. Clearly, a further analysis is required to make this observation relevant in Europe, where surgeons routinely perform 50 or more hemiarthroplasties a year. However, this does start to ask the question: how many of these procedures does one need to perform to reach competence?

Neglected pilon fractures and the Ilizarov technique X-ref

■ There is no doubt that the pilon fracture is one of the most challenging injuries to treat of any fracture. However, the neglected pilon can be even worse. Whilst commonly seen in the developing world, due to a relative lack of access to healthcare, they are also seen in more developed countries. In certain parts of the world, these neglected injuries are becoming more common due to the sharp rise in opioid use and social and medical sequalae associated with this. As such, this paper from **Benha (Egypt)** has global appeal.[7] The authors ask the question: can neglected pilon fractures be treated by the Ilizarov fixator in order to avoid an ankle arthrodesis? The 18 patients they were able to assemble for this series presented an untreated pilon over four weeks after injury. The majority were male and, on average, patients were around 40 years, making this a fairly typical series. Each patient underwent closed fracture reduction and correction of deformity using the standard Ilizarov technique. Outcomes were assessed both using radiographs (alignment, quality of reduction, and arthrosis) and using a clinical outcome score (American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale). The follow-up was somewhat variable, with a mean of 38 months (18 to 168). Patients spent on average 29 weeks in a frame, and there were no deep infections despite there being four open fractures in the group to start with. Ankle dorsiflexion and plantar flexion averaged 34° in the 15 patients who didn't undergo secondary arthrodesis. Overall functional results were surprisingly good, with a mean AOFAS Ankle-Hindfoot score of 83. It seems that in these patients, a closed reduction using the Ilizarov technique is a reasonable option. At the very least, for those patients who do go on to have a secondary fusion, this fusion is less difficult to achieve due to the correction of the anatomical axis.

The next big thing in compartment syndrome?

■ Our understanding of the pathophysiology of compartment syndrome has moved on tremendously. What was once perceived as a purely pressure-related phenomenon has been attacked from all sides, with studies being undertaken into the local metabolism, tissue PaO_2 levels, and a dizzying array of other measurables. Just about anything you can measure in a limb is being measured in a limb. However, whilst the majority of these new and exciting technologies haven't actually made it off the drawing board, spectroscopy has done. The initial papers describing the technique, which are now a few years old, have been surpassed by this latest article from *The Bone & Joint Journal*, which originates in **Athens, Georgia (USA)**. The study evaluated near-infrared spectroscopy (NIRS) with the aim of validating as a clinical measure in continuous, non-invasive setting. The authors report a diagnostic study using 86 patients, all presenting with a severe leg injury, and 23 normal controls. Monitoring was undertaken for up to 48 hours and NIRS values were recorded. A fairly thorough but exploratory approach was taken with the statistics, and the longitudinal data sets were evaluated with graphical methods, bivariate comparisons, and multivariable multilevel modelling. The series included seven patients with compartment syndrome confirmed decompression. The continuous NIRS monitoring was able to pick out those with compartment syndrome in this cohort. On average, there was a 3% drop in NIRS in at least one injured compartment below the uninjured contralateral compartment in all seven patients with known acute compartment syndrome. We are in desperate need for a better diagnostic test for compartment syndrome. In the awake patient, clinical examination remains probably the most sensitive and specific test, and certainly represents the gold standard. However, in the unconscious or anaesthetized patient, compartment pressure monitoring is often used, which

has significant drawbacks. A non-invasive continuous monitoring test would be a very welcome addition to the diagnostic armoury.

REFERENCES

1. Boylan MR, Riesgo AM, Paulino CB, et al. Mortality following periprosthetic proximal femoral fractures versus native hip fractures. *J Bone Joint Surg [Am]* 2018;100-A:578-585.

2. Sprague S, Schemitsch EH, Swiontkowski M, et al. Factors associated with revision surgery after internal fixation of hip fractures. *J Orthop Trauma* 2018;32:223-230.

3. Pincus D, Ravi B, Wasserstein D, et al. Association between wait time and 30-day mortality in adults undergoing hip fracture surgery. *JAMA* 2017;318:1994-2003.

4. Costa ML, Achten J, Bruce J, et al. Effect of negative pressure wound therapy vs standard wound management on 12-month disability among adults with severe open fracture of the lower limb: the WOLLF randomized clinical trial. *JAMA* 2018;319:2280-2288.

5. Olinger CR, Carver DC, Nolan VG, Weinlein JC. The effect of under-dosing prophylactic antibiotics in the care of open tibial fractures. *J Orthop Trauma* 2018;32:322-326.

6. Clement RC, Strassle PD, Ostrum RF. Should all orthopaedists perform hemiarthroplasty for femoral neck fractures? A volume-outcome analysis. *J Orthop Trauma* 2018;32:354-360.

7. Ahmed AA, Singer MS, El Bigawi HA. Neglected tibial pilon fractures: can arthrodesis be avoided? *J Orthop Trauma* 2018;32:369-375.

8. Shuler MS, Roskosky M, Kinsey T, et al. Continual near-infrared spectroscopy monitoring in the injured lower limb and acute compartment syndrome. *Bone Joint J* 2018;100-B:787-797.

Oncology

Margin classification and risk of local recurrence

There are a range of different systems for use in classifying the success or otherwise of soft-tissue sarcoma (STS) excision at the surgical margin. Whilst it is universally agreed that the presence of clear margins is an important factor in prognostication in patients with a STS, what isn't agreed is which of the many classification systems is the best to use. In what has obviously been a mammoth task, investigators in **Toronto (Canada)** have done a good job of shedding light on this question.[1] Their paper revolves around the applications of residual tumour (R) classification, the R + 1 mm classification, and the Toronto Margin Context Classification (TMCC) to a case series of 2217 patients. All patients presented with non-metastatic limb and truncal STS treated with surgical resection and multidisciplinary consideration of perioperative radiotherapy. The authors retrospectively reviewed their excision margins and classified with all three systems. Although the systems share similarities, there are some subtle but important differences. The original residual tumour classification uses microscopic tumour at inked margins, defined as R1. The R + 1 mm classification is similar; however, here, microscopic tumour within 1 mm of ink is defined as R1. For the Toronto Margin Context Classification, positive margins are separated into planned close but positive at critical structures, positive after whoops re-excision, and inadvertent positive margins. The authors then went on to look at survival analysis using competing risks models to establish if there were any differences between the three classification approaches. The authors' results suggest that the original R0, R1, R2 classification is probably the best discriminator where the R + 1 mm (what many would consider an Enneking 'marginal' resection) is in between R0 and R1 risk of LR. There were some additional benefits to the TMCC, which the authors concluded does provide some additional stratification of positive margins at the time of surgery, and may therefore aid in surgical planning and prognostication in these subgroups of patients.

Grade, local recurrence, and survival in chondrosarcomas

Chondrosarcoma is a difficult condition in which to prognosticate. There have been a number of recent cases suggesting that biopsy results may be a rather poor indication of disease-specific survival. This paper from **Birmingham (UK)** sets out to examine the potential value of histological grade and disease-specific survival.[2] The authors were able to include the results of 343 chondrosarcomas, an impressive number, treated at their unit. The patients all had a histological grading performed both at the initial diagnostic biopsy and subsequently at definitive surgery from the resection specimen. The authors treated patients with mixed grade, which is not uncommon in chondrosarcoma; the highest identified grade was used for the purposes of the study. One of the more interesting findings of the study is that only around 40% of patients kept their initial grade determined at biopsy following formal histological examination of the resection specimen. This factor has clearly had a role to play in the difficulty of interpreting the results of previous papers and clinically. In around a third of patients, a small number of cells or focal areas of a higher grade were also seen, which again makes diagnosis tricky. What the authors did establish, however, was that not only is biopsy unreliable in predicting eventual grade of a chondrosarcoma, but that prognosis related to the final highest grade identified in the tumour, and that the highest grade of tumour seen should be that used for prognosis.

Local treatment of Ewing's sarcoma within a randomized controlled trial

One of the better recent randomized controlled trials looking at outcomes in musculoskeletal tumour was the European Intergroup Cooperative Ewing's Sarcoma Study (EICESS)-92. The trial randomized patients to different chemotherapy options in Ewing's sarcoma and was undertaken by two national clinical trial groups: one in the United Kingdom (Children's Cancer and Leukaemia Group (CCLG)) and one in Germany (German Paediatric Oncology and Haematology Group (GPOH)). An unexpected outcome of the trial was the observation that the survivals were different between the patients in the different trial networks. This rather overdue paper from multiple centres in the **United Kingdom** and **Germany** analyzes why there was an unexpected difference in survival between the two countries.[3] In the initial study, a total of 647 patients were randomized to one treatment or another. Cox regression analyses were used to compare event-free survival (EFS) and overall survival (OS) between the two study groups. The five-year EFS rates were 43% and 57% in the CCLG and GPOH study networks, respectively, giving OS rates of 52% and 66%. The authors went on to explore differences in the treatment regimes that may have accounted for the marked differences in survivals. The clearest differences were in the chances of the English cohort having both surgery and radiotherapy (18% *vs* 59%); there were also higher rates of preoperative radiotherapy in the German cohort (45% *vs* 3%). The most striking finding of this study is that after adjusting for age, metastases, primary site, histology, and local treatment modality, the risk of an EFS event was 44% greater in the