practice since their introduction. Although there is still much enthusiasm within the surgical fraternity, concerns surrounding excessive bone formation and the possibility of tumorigenesis have somewhat tempered this, and, in the absence of any definitive clinical trials proving efficacy, there is certainly less and less appetite for the use of BMPs as time passes. We were delighted to see this systematic review from **London (UK)**, which tackles the rather difficult dual questions of safety and efficacy based around the published reports in the indexed literature.[7] The review team's search included all published reports about spinal fusion where the fusion rates were assessed using either plain film or cross-sectional imaging. A total of six studies were deemed suitable for inclusion in the review, reporting the outcomes of 203 patients. Of these, there were four comparisons of bone graft *versus* BMP-2, and two reporting the outcomes of BMP-assisted fusion alone. The bottom line from this study is that BMP-2 appears safe to use (with no increase in the reported rates of complications over bone graft); however, it also appears ineffective, with no differences in the reported rates of radiological union at 24 months of follow-up. The authors conclude that "BMP-2 is safe and effective" but offer the caveat that this is really only suitable for clinical use when bone graft is contraindicated. We are, of course, somewhat struggling to think of a clinical situation in which bone graft is contraindicated but BMP could be of use. The state of play appears to be that, at present, the only difference between BMP and other forms of bone graft is really the cost.

Magnetic growing rods and the law of diminishing returns **X-ref**

■ Magnetic growing rods are a rather attractive option in the arsenal of the paediatric scoliosis surgeon. Offering the advantage of familiar instrumentation and the ability to harness the powerful correction provided by pedicle screw instrumentation, the growing rods afford the added benefit of allowing for spinal growth, and thereby not limiting stature or running the risk of complications seen in patients with long segments of fusion. Magnetic growing rods potentially offer a range of benefits over the traditional growing rods, which require multiple operations to achieve their growth and often seem to be governed by the law of diminishing returns. Surgeons in **Oxford (UK)** sought to determine how this conventional wisdom fits with magnetic growing rods over a series of distractions.[8] The authors report the outcomes of a total of 35 patients with variable follow-up to a maximum of nearly five years. The study focuses on the comparison of true distraction (TD) (defined at the expansion gap measured on fluoroscopy) and intended distraction (ID). Over a mean follow-up of 30 months, there was a decrease in the TD/ID ratio. This was seen with both convex and concave rods and the mean ratio decreased from 0.81 to 0.17 with convex rods, and 0.93 to 0.18 with concave rods. This clearly indicates that the law of diminishing returns is seen after serial distraction using magnetic growing rods. However, there were also some further conclusions that the authors were able to make from their series. The diminishing returns were linear with a gradual decline in lengthening, and are associated with a reduced distraction ratio in older, heavier children.

REFERENCES

1. Chang DG, Healey RM, Snyder AJ, et al. Lumbar spine paraspinal muscle and intervertebral disc height changes in astronauts after long-duration spaceflight on the International Space Station. *Spine (Phila Pa 1976)* 2016;41:1917-1924.

2. Javanshir N, Salehpour F, Aghazadeh J, Mirzaei F, Naseri Alavi SA. The distribution of infection with Propionibacterium acnes is equal in patients with cervical and lumbar disc herniation. *Eur Spine J* 2017;26:3135-3140.

3. Liu J, Hai Y, Kang N, Chen X, Zhang Y. Risk factors and preventative measures of early and persistent dysphagia after anterior cervical spine surgery: a systematic review. *Eur Spine J* 2017 (Epub ahead of print) PMID: 28988275.

4. Schoenfeld AJ, Sturgeon DJ, Burns CB, Hunt TJ, Bono CM. Establishing benchmarks for the volume-outcome relationship for common lumbar spine surgical procedures. *Spine J* 2017 (Epub ahead of print) PMID: 28887272.

5. Chan P, Skaggs DL, Sanders AE, et al. Pain is the greatest preoperative concern for patients and parents before posterior spinal fusion for adolescent idiopathic scoliosis. *Spine (Phila Pa 1976)* 2017;42:E1245-E1250.

6. Takahashi S, Hoshino M, Terai H, et al. Differences in short-term clinical and radiological outcomes depending on timing of balloon kyphoplasty for painful osteoporotic vertebral fracture. *J Orthop Sci* 2017 (Epub ahead of print) PMID: 28988630.

7. Bodalia PN, Balaji V, Kaila R, Wilson L. Effectiveness and safety of recombinant human bone morphogenetic protein-2 for adults with lumbar spine pseudarthrosis following spinal fusion surgery: A systematic review. *Bone Joint Res* 2016;5:145-152.

8. Ahmad A, Subramanian T, Panteliadis P, et al. Quantifying the 'law of diminishing returns' in magnetically controlled growing rods. *Bone Joint J* 2017;99-B:1658-1664.

Trauma

X-ref ***For other Roundups in this issue that cross-reference with Trauma see: Foot & Ankle Roundup 4; Wrist & Hand Roundup 8; Shoulder & Elbow Roundups 1 & 2; Spine Roundup 6; Oncology Roundup 2; Research Roundup 7***

Postoperative CT in acetabular fracture reliably predicts hip survivorship

■ Pelvic and acetabular surgeons have a reputation for being fastidious about their surgery and for spending long periods of time in the operating theatre seemingly chasing the 'perfect' reduction. Despite this focus on surgical excellence, there is often a single common pathway for severe acetabular fractures in the end: that of total hip arthroplasty (THA). Although acetabular surgeons maintain that a perfect anatomical reduction improves outcomes, there has been precious little to support this perspective, and with postoperative radiographs often obscured by plates and screws, it has been somewhat tricky in the past to prove or disprove this widely held belief. Surgeons from the Hospital for Special Surgery in **New York, New York (USA)** have set out to prove the widely held belief that reduction really does matter.[1] The surgical team included 211 patients, all of whom had undergone acetabular fracture reduction and fixation and had at least two years of clinical follow-up data available. All patients had both plain film radiographs and postoperative CT scans available. The authors undertook a stratified analysis using Matta's original criteria (articular reduction step-off of 0 mm to 1 mm, anatomic; 2 mm to 3 mm, imperfect reduction; and > 3 mm, poor reduction). The outcomes assessed were conversion to total hip arthroplasty, and Kaplan–Meier survival analysis was used to establish the survival of the native hip following acetabular fracture surgery. The mean follow-up of nine years yielded an impressive 76% native hip survival rate. The CT scans were better at demonstrating deficiencies in reduction, and in 59% of hips there was a poorer reduction shown on postoperative CT than on the radiograph. When the quality of reduction on CT was used to stratify patients, the quality of reduction was seen to be markedly linked to eventual

outcome. There were 99 patients graded as having adequate reduction on CT, of whom 10% underwent conversion to THA; 36% of those with an inadequate reduction underwent conversion to THA. As would be expected, there was a significant difference in survival curves. Helpfully, the authors undertook a covariant analysis and established that mean hip survivorship was poorer in patients ≥ 50 years of age who had an inadequate reduction on CT. The independent risk factors for conversion to THA were age (hazard ratio (HR) 4.46), inadequate reduction (HR 3.57), and posterior wall involvement (HR 1.81). Gender, fracture type (elementary *vs* associated), and year of surgery did not influence hip survivorship. The results of this study are valid intuitively and will be widely well-received within the pelvic and acetabular community. However, this study is the first to demonstrate that CT scans are superior to radiographs when assessing the reduced condition of acetabular fracture. Clearly, when it comes to the hip, which is a congruent and highly constrained joint, striving for that perfect reduction is worthwhile.

Predicting in-hospital mortality after hip fracture surgery

The Nottingham Hip Fracture Score (NHFS) has become a widely accepted and validated tool for predicting the 30-day mortality of patients admitted with hip fractures based on comorbidites, demographics, and admission bloods. Although the NHFS is widely accepted and independently validated, it is for mortality at 30 days, not for in-hospital mortality. These authors from **Boston, Massachusetts (USA)** and **Tokyo (Japan)** used a large database (the National Inpatient Sample) and were able to extract data on 535 475 patients aged over 50 years, all of whom had hip fracture surgery.[2] The statistically minded will know that a prediction model is only really as good as the fidelity of its data. The use of a large data set with reliably collected data fields allowed these authors to develop a potentially comprehensive prediction model for in-hospital mortality after hip fracture surgery. They identified eight essential predictors (age, timing of surgery, male gender, congestive heart failure, pulmonary circulation disease, renal failure, weight loss, and fluid and electrolyte disorders) from the range of candidate covariates, and constructed their risk predication score based on this. Using a receiver operating characteristic analysis, the prediction model achieved an area under the curve of 0.74, which equates to a 'good' predictive value. The genius of this model is that it is simple and predicts inpatient mortality reliably.

Autologous fibular strut grafting in open fractures

One of the golden rules of orthopaedic trauma surgery is not to use graft of any type in contaminated open fractures until the wound bed is completely clean, due to the high rates of failure. This has historically put surgeons in the slightly awkward position of trying to reconstruct bone defects in severe open fractures without being clear when exactly it is and is not safe to use allograft. This may be in part the reason that the Masquelet (induced membrane and morsellized allograft) technique has risen in popularity. However, there have been some contemporary reports suggesting that the Masquelet technique may not be as successful as we first thought, with some reports of high failure rates. These authors from **Hyderabad (India)** reported on the other option for graft reconstruction: the use of the bulk fibulae allograft.[3] Their technique was that of a staged reconstruction, and all patients included in the series had supracondylar fractures of the femur and autologous fibulae strut allograft. The authors report a consecutive series of 18 patients, all with open supracondylar fractures of the femur with an intra-articular extension. The authors' protocol was a staged fibular strut graft (single in 12 and dual in 5, all with cortico-cancellous bone grafting). The primary outcome reported was clinical and radiological union, with secondary outcomes of knee clinical outcome scores. The authors concluded that the technique is promising, with a good safety profile and long-term efficacy. However, although aspects of the outcomes were excellent, such as the union rate, the reported results are not all as positive as the paper's commentary would have the reader believe. Only a single patient achieved an excellent result, with six achieving a poor or fair result. Only nine patients achieved a knee range of motion > 80°, with a mean range of motion of 49°. Nevertheless, the fibula strut allograft is something to keep in the limb reconstruction armamentarium, and this paper highlights its usefulness, particularly in the femur.

Anteromedial *versus* anterolateral plating and the compartments

These authors from **Bangkok (Thailand)** report their cadaveric study, which aims to report the differences in tibial shaft percutaneous plating,[4] reasoning that compartment syndrome is a risk that we would all rather avoid, and that plating, while far from the benchmark, is gaining some traction. There are two workhorse approaches for this: anterolateral and anteromedial. By its very nature, percutaneous surgery runs the risk of compartment syndrome, as the fascia compartments are not fully opened and the plate is placed within an essentially closed fascia compartment, increasing the compartmental pressure. There is no data to support one approach over another from the perspective of compartmental pressures, and this simple paper aims to establish the efficacy of the two plating approaches in this regard. The authors took eight soft cadaveric legs and created some near physiological conditions by infusing normal saline until a sustained pressure of 20 mmHg was achieved in all the compartments. The investigators then undertook a percutaneous plating and measured the immediate shift in compartmental pressures using the standard Stryker needle system. The anterolateral plate insertion resulted in higher intracompartmental pressure elevation of the anterior compartment when compared with the anteromedial approach. The anteromedial approach resulted in a mean rise of anterior compartment pressure of 0.375 mmHg, compared with the anterolateral approach, which resulted in a mean rise of 3.5 mmHg. While there was a clear difference here, one does have to ask the question: given the other factors combined, would a relative pressure increase of 2.2 mmHg really be clinically significant?

Fracture-site mobility predicts nonunion without surgery

Ever since the original publications from Sarmiento suggesting that there is a comparable outcome from a functional hydrostatic brace to open reduction and internal fixation (ORIF), the humble humeral shaft fracture has been the source of consternation. The high loss to follow-up in his series and the high nonunion rate, which predisposes patients to more complex nonunion surgery with the risk of radial nerve damage, have been the commonest sources of debate over the years. It is now almost universally accepted that when a humeral shaft fracture heals successfully in brace without the development of elbow stiffness, this is the most desirable and clinically successful outcome. It is also accepted that nonunion surgery carries with it poorer functional results and higher complication rates than primary ORIF. The current literature suggests that if those patients who are at risk of nonunion could be predicted, then patients could probably be allocated to the most likely successful outcome. This

team of surgeons from **New York, New York (USA)** have set out to test the hypothesis that fracture-site mobility at a six-week follow-up point is predictive of success in conservative treatment.[5] The study team retrospectively reviewed the outcomes of 84 consecutive patients, all undergoing nonoperative treatment of a diaphyseal humeral shaft fracture. Patients were followed up until fracture union or nonunion surgery, and the main outcome was the clinical finding of instability at the fracture site. Overall, the union rates in this series were good, with a union rate of 87% (n=73) at six months post-injury. Of the 11 patients who went on to develop a nonunion, eight underwent surgical treatment. The authors found that the clinical examination of fracture-site motion at six weeks following injury predicted nonunion development of the humeral shaft with 82% sensitivity and 99% specificity. Of the 11 patients with fracture-site motion at six weeks, only one went on to successful union. The authors concluded that when there is gross fracture motion six weeks following injury, knowledge of the nonunion risk can be used in the shared decision-making model when counselling about early surgical options.

The Targon Femoral Neck (TFN) locking plate system

Despite the frequency of presentation and the millions of dollars poured into the development of novel devices and the refinement of existing devices, there is still an appreciable complication rate associated with hip fracture surgery. This includes hardware failure, nonunion, avascular necrosis, and screw cutout. The Targon Femoral Neck (TFN) plate system has been developed with the aim of addressing all of these problems. It is essentially a dynamic hip screw (DHS)-style device that has multiple telescopic screws providing controlled collapse, multiple points of fixation, and angular stability. The aim was to take the best features of the DHS, cannulated screws, and intramuscular nailing systems, then combine them into a single device. This kind of design approach usually yields either a superb device or a disaster. This designer surgeon series from **Peterborough (UK)** sets out to establish which of these categories the TFN falls into.[6] The paper is essentially a retrospective review of the outcome of 2004 intracapsular hip fractures treated with either the Targon Femoral Neck locking plate system (n=725, 36.2%) or standard fixation using cannulated cancellous screws (n=1279, 63.8 %). The authors report the revision rates of this device in a nonrandomized retrospective series. In terms of nonunion, the TFN was superior to the multiple cannulated screw (MCS) fixation group, in which there were higher rates of nonunion (19.5% *vs* 9.5%) and revision surgery (19% *vs* 9%) during the first year in the cohort treated with cannulated cancellous screws – presumably for the same indication. Revision surgery was also higher in the same group during the whole of the follow-up period (22.2% *vs* 14.9%). The authors concluded that the Targon Femoral Neck locking plate system was associated with lower rates of nonunion, revisions, and reoperations for any cause. While this seems to be a reasonable conclusion, we do need to be somewhat sceptical about series like this that essentially set out to prove that the device in question is better than the previous device. There will, of course, be some biases in any designer surgeon series. Particularly with a new implant, the surgery is likely to have been performed by a technically excellent surgeon with an intimate knowledge of the device; the same may or may not be true for the MCS group. We are also somewhat concerned here at *360* by the indications for the MCS group. The high rate of complication and nonunion is above that seen in other series, suggesting that the indications may have been stretched – perhaps a fairer comparison would have been to the venerable and angular stable DHS?

Age and major trauma

There is a growing problem with multiple injury in the older population. Just ten years ago, the incidence of polytrauma in the geriatric population was low; however, with pushes towards independent living, an ageing population, and a cohort of patients with significant comorbidities now living alone, it has become increasingly common for older patients to be polytraumatized from lower-energy mechanisms, such as falling down the stairs. Despite this rise in presentations, very little is known about the mortality and current management of these patients. Researchers in **Manchester and Middlesborough (UK)** have used the United Kingdom's trauma population registry, Trauma Audit & Research Network (TARN), to establish the scale of the problem, and to find out how the older patients compare with their younger counterparts in terms of injury severities, interventions, and comorbidities.[7] The review spanned three years (April 2012 to June 2015) and included 142 765 majorly injured patients, of whom 72 942 had long bone or pelvis injuries. The mechanisms of injury were vastly different, with the younger population most commonly injured in road traffic accidents (40%) and older patients most commonly falling from standing (80%). The overall 30-day mortality was greater in older patients with fractures (6.8% *vs* 2.5%). There was a clear burden of both disease and treatment on the orthopaedic teams, with 82% of procedures undertaken in the older population being for fracture surgery. The differences in patterns of injury and treatment have previously been widely accepted but poorly studied. This group have added a huge amount to what is known about significant injury in the elderly. The simple observation

that 80% of surgeries are for orthopaedic injuries should lead to the development of combined models of care, in order to improve outcomes and reduce complications and hospital stays in this group.

LIPUS in brief

We were delighted to come across this secondary economic analysis of the Thyroid Hormone Replacement for Subclinical Hypothyroidism Trial (TRUST) study. TRUST was a large 500+ patient multicentre randomized trial to establish the benefit (or otherwise) of low-intensity pulsed ultrasound (LIPUS) on tibial shaft fracture treatment in the setting of a closed fracture following intramedullary nailing. The trial used placebo 'decoy' boxes and active boxes. The primary outcome of the study was fracture healing; the economic analysis is also reported. The authors measured health-related quality of life utilizing the Health Utilities Index Mark-3, and then used this to derive quality-adjusted life years (QALYs). In addition, both payer and societal costs were calculated. At the time of the study, the cost per device was $3995, giving a significantly higher LIPUS cost. There was also no significant improvement in QALYs, with a mean difference of 0.02. As would be expected, there was an unacceptably high cost of $155 433 from a payer perspective and $146 006 from a societal perspective associated with LIPUS use. We suspect this is a device that will be consigned to the history books.

REFERENCES

1. Verbeek DO, van der List JP, Villa JC, Wellman DS, Helfet DL. Postoperative CT Is superior for acetabular fracture reduction assessment and reliably predicts hip survivorship. *J Bone Joint Surg [Am]* 2017;99-A: 1745-1752.

2. Endo A, Baer HJ, Nagao M, Weaver MJ. Prediction model of in-hospital mortality after hip fracture surgery. *J Orthop Trauma* 2017. (Epub ahead of print) PMID: 29076984.

3. Iyengar R, Cherukuri N, Patnala C. Reconstruction of traumatic, open supracondylar femoral fractures by autologous fibular strut grafting and cortico-cancellous bone grafting - a single centre, observational study. *J Orthop Trauma* 2017. (Epub ahead of print) PMID: 29076982.

4. Amarase C, Thimasarn W, Tantavisut S, et al. Different effect of percutaneous plate insertion via anteromedial vs anterolateral approach on intracompartmental pressure of the leg: A cadaveric study. *Injury* 2017;48:2407-2410.

5. Driesman AS, Fisher N, Karia R, Konda S, Egol KA. Fracture site mobility at six weeks following humeral shaft fracture predicts nonunion without surgery. *J Orthop Trauma* 2017. (Epub ahead of print) PMID: 28708781.

6. Alshameeri Z, Elbashir M, Parker MJ. The outcome of intracapsular hip fracture fixation using the Targon Femoral Neck (TFN) locking plate system or cannulated cancellous screws: A comparative study involving 2004 patients. *Injury* 2017;48:2555-2562.

7. Herron J, Hutchinson R, Lecky F, et al. The impact of age on major orthopaedic trauma: an analysis of the United Kingdom Trauma Audit Research Network database. *Bone Joint J* 2017;99-B:1677-1680.

8. Tarride JE, Hopkins RB, Blackhouse G, et al. Low-intensity pulsed ultrasound for treatment of tibial fractures: an economic evaluation of the TRUST study. *Bone Joint J* 2017;99-B: 1526-1532.

Oncology

Predictors of venous thromboembolism in patients with primary sarcoma of bone

Venous thromboembolism (VTE) is known to be independently associated with both orthopaedic surgery and malignancy. However, although patients undergoing surgery for musculoskeletal malignancies are at an increased risk of thromboembolism, there is very little in the way of evidence on which to base practice in this group. In this retrospective study from **Boston, Massachusetts (USA),** the authors report the outcomes of 379 orthopaedic oncology patients with at least 90 days of postoperative follow-up from the index surgery.[1] In this cohort, 21 patients (5.5%) had a clinically symptomatic, and radiologically confirmed, VTE within 90 days of index surgery (12 had a deep vein thrombosis (DVT); nine had a pulmonary embolism (PE)). The reported rate of VTE in this series represents only those that were clinically symptomatic and treated at their primary institution. This is therefore the lowest estimate of the actual rate, as it will not include subclinical events or those treated at outside institutions. The median time to event was 27 days. Although this cohort contained just 21 events, to our knowledge, here at 360, it is by far the largest series of patients exploring VTE following orthopaedic oncology surgery and, as such, the authors went on to explore what they could glean from the series in terms of potential risk factors. They undertook an analysis of potential risk factors and report that a higher preoperative white blood cell count (possibly a reflection of haemoconcentration, which *per se* is prothrombotic in nature) and postoperative wound complications were found to be independent risk factors for VTE. There were no differences in this series in terms of efficacy among the various available antithrombotic medications. Nonetheless, the risk of wound complications increased significantly in patients who received chemical thromboprophylaxis (odds ratio (OR) 2.21). This observation prompted the authors to make the suggestion that aggressive DVT prophylaxis may actually increase the risk of thromboembolic events. They argue that prolonged immobilization and additional surgical interventions are likely to be required when addressing postoperative wound complications. They then make the reasonable recommendation that prospective randomized trials comparing different medications in combination with compressive devices are needed to assess efficacy with the lowest complication profile, and that simpler protocols may increase patient compliance with prophylactic treatment. This, of course, is a tall order in the normal orthopaedic populations, and some observers may feel it is near impossible in the much rarer surgical oncological patients.

Carbon fibre-reinforced intramedullary nailing in bone metastasis X-ref

Traditional intramedullary nailing makes use of titanium cannulated interlocked nails, a venerable technology that has evolved through the past few decades. Nevertheless, despite the almost universal dominance of titanium nails, there are several other options available. One of the newest is carbon fibre-reinforced (CFR) nailing, which involves polyetheretherketone (PEEK) and has a couple of significant advantages. The carbon fibre enables a controlled response when stresses are applied to the implants in an anisotropic manner, which is much more difficult to achieve with titanium, and the radiolucency of the implant allows for surveillance of the fracture and metastasis. This series from **Italy** reports one of the few series on the use of these nails in musculoskeletal tumour surgery, with the longest available follow-up.[2] The authors report 53 adult oncology patients, all of whom had either pathological fracture or impending fracture requiring stabilization. The surgery in every case was undertaken using a CFR nail. The patients in this series included the usual distribution of long bones (humerus, n=35; femur, n=11; tibia, n=7). The appearance of callus, the response to radiotherapy, and the clinical status of the patient's tumour were recorded. Hardware survival and failure, breakage, and need for implant revision were also reported as secondary outcomes. In terms of adverse events, the authors report a relatively high rate of intraoperative (13.2%) and postoperative (7.54%) complications. Eight patients had local progression and one developed a stress fracture proximally to the distal static screw. The chief advantage of CFR implants in orthopaedic oncology is that, unlike metal implants (titanium or stainless steel), they are radiolucent and, therefore, fracture reduction and healing can be assessed more easily. In oncology patients, the use of CFR-based implants enables monitoring of the consolidation of the pathologic fracture, local recurrence, progression, or response to therapies without obstruction of the metallic implant. Moreover, because of their low atomic number and radiation properties like the surrounding tissues, the CFR devices are inert to ionic radiation and give minimal disturbance on the irradiation dose distribution during radiotherapy. The potential disadvantages are that CFR nails are not contoured, humeral nails are not cannulated due to the