

Markers of bone turnover a nonunion predictor **X-ref**

■ Symptomatic nonunion is a relatively common and well recognised complication following spinal fusion. This can result in lengthy, complicated revision surgery. The authors of this study from **Tokyo (Japan)** have looked at whether there is a correlation between markers of bone turnover and fusion, with the aim of developing a test to predict whether an individual is at risk of nonunion. The authors assessed the influence of several factors, such as age, gender, number of fusion levels, smoking, and albumin, as well as markers of bone turnover, in a lumbar fusion cohort of 74 patients, of whom 13 were diagnosed with a nonunion.¹ They selected two specific markers of bone metabolism: procollagen type 1 amino-terminal propeptide (P1NP), which is a marker of new collagen synthesis; and tartrate-resistant acid phosphatase 5b (TRACP-5b), a marker of bone resorption. The advantage of these two markers is that they are unaffected by renal failure or fasting and there is no diurnal variation. However, they are systemic rather than specific localised markers. The authors then devised a bone turnover ratio (BTR), which consists of the serum TRACP-5b divided by P1NP. The study reports the outcomes of 74 patients, all undergoing lumbar spinal fusion, of whom 13 were diagnosed with nonunion. The factors identified that were associated with nonunion included older age, malnutrition and a low-serum P1NP. When considered as a single parameter and using logistic regression analysis, the BTR became a significant risk factor for nonunion, with a high BTR having an increased tendency for bone resorption and thus nonunion. The authors acknowledge the small study size but suggest that the BTR can be used to identify high-risk individuals who may benefit from therapeutic

interventions such as bisphosphonate therapy to achieve bone fusion.

Consent in lumbar spinal surgery

■ The consent process is a key step in a patient undergoing surgery, with significant medico-legal implications. The General Medical Council has issued advice to doctors, and several landmark legal cases have also influenced recommended practice in the UK particularly the Montgomery ruling, which calls for individualised consent exploring not only the treatment proposed, but other options as well. Current guidelines are that patients should be counselled regarding the risks and benefits of surgery but also be made aware of the alternatives to surgery. The authors of this study from several centres in the **UK** have investigated the standard of consenting in their respective units for patients undergoing elective lumbar decompressive surgery.² In addition to using a standard assessment of consent, they assessed patient recall of the content of consent as well as factors affecting recall. The authors decided upon a set standard based on the GMC guidance: the ideal consent process for this procedure would involve a discussion on the alternatives to surgery (physiotherapy and epidural injections), the benefits (reduction in pain) and the risks (paralysis, sphincter disturbance or cauda equina syndrome, infection, haemorrhage, dural tear with cerebrospinal fluid leak, and recurrence). The consent forms and case notes were assessed to determine the documented adequacy of consent against this standard, and patients were contacted within 24 hours of surgery to assess recall. The study reports the outcomes of the consent process of 153 inpatients treated in four centres, and 108 patients were interviewed within 24 hours before or after surgery to

assess recall. Overall consenting practice was classified “suboptimal”, and patient recall was lower still. There were significant variations between centres with regard to discussing haemorrhage and sphincter disturbance. The most commonly documented risk was infection (96.1%) while the lowest was 52.3%. Patients most commonly recalled paralysis as a risk (50.9%) and recurrence least (6.5%). Surgical trainees’ documentation was similar to that of consultants in all areas except that they recorded haemorrhage more frequently. Patient recall was unaffected by consent seniority. This study highlights inadequate practice and low patient recall, which is a potential litigation concern. What is the solution? The authors suggest that patients should instead complete a request for treatment form (RFT) where they are obliged to state the procedure, risks and benefits, and in doing so address any issues of understanding they may have.

Optimising main curve correction in scoliosis **X-ref**

■ The general trend in paediatric spinal deformity surgery is to reduce spinal implant density, be it with pedicle screws or hooks by skipping levels, and fixing alternate segments. The potential benefits include a reduction in surgical time, blood loss, implant costs and risks associated with using fewer implants (particularly iatrogenic neurological injury). The authors of this study have retrospectively investigated the relationship between fixation anchors (pedicle screws or hooks) and main curve correction following posterior adolescent idiopathic scoliosis surgery to establish if this is a reasonable approach. This study team from **Montreal (Canada)** have evaluated the outcomes of 137 adolescent idiopathic scoliosis (AIS) patients operated from a posterior-only approach using hooks and

pedicle screws.³ The sample was a representative cohort of normal practice, and the authors analysed the effect of implant density (ID) on curve correction, with ID defined as the number of fixation anchors or pedicle screws divided by the number of available anchor sites within the main curve (two per spine level). Multiple linear regression analysis was performed to allow the authors’ analysis to take into account variables such as age, gender, curve type and, perhaps most importantly, pre-operative Cobb angle, number of fused levels and number of levels within the main curve. The findings here are clear and an excellent guide to clinical practice. An ID $\geq 70\%$ and $< 90\%$ provided a correction similar to that obtained when placing fixation anchors at every level (ID $\geq 90\%$). However, patients with an ID $< 70\%$ achieved inferior correction compared with constructs with an ID $\geq 90\%$. The authors rightly conclude that once an ID of 70% is achieved, the limiting factor for curve correction becomes the intrinsic deformity (vertebrae, disc, rib cage) which limits any further correction, and so further fixation segments become unnecessary. It was harder to draw a meaningful conclusion with regard to the effect that ID had on sagittal correction; the results did not show a clear influence and the ideal final thoracic kyphosis is clearly different from patient to patient whereas in the coronal plane, the surgeon is aiming for maximal Cobb angle correction.

The recurrent laryngeal nerve and anterior cervical surgery

■ The recurrent laryngeal nerve (RLN) is known to be at risk during anterior approaches to the cervical spine. As a complication, damage to the RLN is a serious one, and leads to severe and lasting morbidity. Clinical data are somewhat imprecise in their estimation of suggesting



that the RLN is injured in 0.1% to 11.3% of anterior neck cases. In response, we are trained to refrain from using right-sided approaches to the anterior cervical spine in order to avoid the convoluted, variable and complicated course of the right RLN, and to opt in the most part for left-sided dissections instead. However, this may not always be appropriate. Right-sided pathology and being a right-handed surgeon are just two situations where a surgeon might be tempted to tackle a right-sided anterior neck approach. What is needed in order to make this safe is an accurate description of the anatomy of the RLN and, in particular, its relationship to the cervical fascia. Fortunately, a group from **Beijing (China)** have carried out a good old-fashioned anatomical study to do just that, focusing on the relationship between the carotid sheath and visceral fascia and the right RLN, where it is most vulnerable, thereby providing a valuable resource for those undertaking the 'right side of the neck' approach.⁴ The group carried out an anatomical study and dissected the anterior neck of 42 embalmed cadavers to explore the route of the right RLN. Although variable, the course of the nerve is somewhat predictable. The right RLN pierced the alar fascia at the lower edge of T₁ in 52% of patients, and at the upper edge of T₁ in 48%. They then showed that the visceral fascia is pierced at C₇/T₁ in 25/42 cases, with the remainder piercing at upper T₁. Beyond this, the nerve runs in

the tracheoesophageal groove out of harm's way. The nerve is at risk from sharp dissection, avoidable if the above is borne in mind, but is more likely to be at risk of traction injury when the fascia is put under tension after separating fascia from the carotid sheath. This is particularly the case when more than two levels are being worked on during a case. The authors comment that the fascia should be separated as close to the carotid sheath as possible and that any tension applied to fascia should be regularly released. Unfortunately, this paper is a little hard to follow and we suspect some detail has been lost in translation. However, surgeons can now operate on the right side of the neck with an improved understanding of the layout of the fearsome right RLN, safe in the knowledge that if traction injury is considered, approaching cranial to C₇ carries with it a reduced risk of injury to the right RLN.

Lumbar disc herniation surgery: do older patients do better?

■ Lumbar disc herniation surgery is a common procedure carried out by spinal units throughout the world. The classical teaching has always been that one would expect that the older a patient is, the less successful the outcome of any procedure, whereas younger patients might be expected to fare better. However, according to a group from **Malmö (Sweden)** this 'fact' is perhaps lacking in evidence to support it.⁵ They have sought to test this assumption using a large register of a national prospectively collected dataset (SweSpine). Uniquely, the authors are using exactly the same outcome measures for all of the groups involved, allowing easy comparisons between them. The results of this study are based on the authors' analysis of 11 237 patients, each of whom had received surgery for lumbar disc herniation (open ± microscopic discectomy, decompression without fusion, decompression with fusion) over a ten-year period

across Sweden. Patient-reported outcomes including SF-36, EQ-5D and the Oswestry Disability Index scores were collected pre-, peri-, and post-operatively at one year to assess referral patterns, severity of symptoms and improvement following surgery. Outcomes were reported in age strata, and at all of the time-points, older patients persistently showed poorer functional scores than younger patients. However, for each stratum, surgical intervention improved quality of life and reduced disability. The extent of the improvement diminished as the age of the patient rose, as did the number of surgical complications. Despite this, patient satisfaction with surgery was high across the board, and most reached a successful outcome. Why should older people do worse, and does it matter? Older patients suffer from increased comorbidities, polypharmacy and slow rehabilitation, and these interactions all play a role in outcomes. The authors note that older patients often with pathology higher up the spine, have accompanying degenerative change and may suffer an increased inflammatory response to disc herniation. The significance of these isn't clear, but this study shows that older patients should be counselled that, although they will be better following surgery, their improvement won't match that of a younger patient. Despite this, it is likely that they will be satisfied with their result.

Implanting spinal implants after deep spinal infection. Anathema?

■ It would typically go against every osteon in our surgical bones to implant hardware into an infected surgical bed. Terms familiar to the arthroplasty surgeon come to mind - biofilm, glycocalyx, non-sessile bacteria, and so on. But what to do with a patient with a deep spinal infection and accompanying instability? It is likely that they will have a problematic recovery if some semblance of stability is not restored, and with up to two admissions per

100 000 being due to unstable deep spine infections, it's an uncommon but serious problem. A group from **Singapore** have come forth with a retrospective cohort study of 84 patients with a two-year follow-up, each of whom underwent surgical treatment for deep spinal infection.⁶ The study team set out to establish the rates of re-operation, relapse of infection and, as a secondary measure, mortality. Importantly, patients were selected on the presence of typical features of infection (systemic inflammatory response, radiological evidence), not just cultures, which have notoriously variable results. The results of 84 patients with an average age of 62 years were the basis for this study. All had an unstable spine infection affecting predominantly the lumbar spine (unsurprisingly, chiefly osteomyelitis and spondylodiscitis). The majority were caused by *Staphylococcus aureus* and patients were treated with a combination of either antibiotics alone, antibiotics with debridement, or antibiotics with debridement and instrumentation. At two years post treatment, the authors found no differences in the rates of re-operation or relapse between the three groups, however, there was a statistically significant lower rate of crude mortality in the debridement, and debridement with fusion, groups (OR 0.80 and 0.82, respectively) with all the limitations that accompany such a comparison. The reason for this difference is not entirely clear; perhaps these patients are frail and at high surgical risk, perhaps it's because surgery improves the penetration of antibiotics, or perhaps surgery reduces the bacterial load. Certainly, the improved blood supply of the axial over the appendicular skeleton could reduce the clinical significance of a biofilm forming on the implants with subsequent reduced resistance to ongoing antibiotic chemotherapy. In short, this study suggests that implants can be put into the infected spine with ongoing antibiotic treatment, and that at two years,

there appears to be no relapse of infection, no need for re-operation, and perhaps better survival. These findings are more in keeping with those seen in infected nonunions and fracture fixations than in arthroplasty. What appears to be clear is that an infected unstable spine is more of a problem than an infected stabilised spine.

Teriparatide and union in lumbar fusion X-ref

■ It is miserable to see a patient who has undergone a fusion procedure for lumbar spine-related pathology using either a posterior lumbar interbody fusion (PLIF) or a transforaminal lumbar interbody fusion (TLIF) approach which fails to fuse, often leaving the patient with ongoing pain and sometimes even instability. Teriparatide (a recombinant form of parathormone including just the first 34 nucleotides which are the bioactive form) is starting to find relatively wide application in patient groups with recalcitrant fractures or difficult-to-treat osteoporosis. Despite promising early results in treatment of nonunions, particularly those very difficult-to-treat bisphosphonate-associated fractures, there are few objective studies into efficacy. We were delighted, therefore, to read this paper from **Yamanashi, Japan** testing the efficacy of teriparatide as an adjunctive treatment when undertaking TLIF or PLIF in degenerative lumbar spine diseases as an adjunct to increase fusion rates.⁷ The authors have designed and reported a randomised controlled trial with the primary endpoint of radiological

fusion rates. In the end, 66 patients were randomised to either standard care, no teriparatide, or weekly teriparatide administered subcutaneously from the first week post-operatively to six months. All patients in the study were women over the age of 50 years with a bone mineral density (BMD) of < 80% and secondary outcome measures included the clinical evaluation, neurological symptoms and two patient-reported outcomes (Japanese Orthopaedic Association Back Pain Evaluation Questionnaire and the Oswestry Disability Index). By four months post-operatively, bone fusion in the two central CT slices was significantly higher in the teriparatide arm compared with the control arm in the intention-to-treat analysis, and was significantly higher at six months in the per-protocol analysis. There were no differences in functional scores, and no apparent differences in complications. It certainly appears that the use of teriparatide is a positive in this small study and increases bony union rates. However, without a significant difference in satisfaction rates, the cynical among us would argue that simply treating the radiograph, rather than the patient, is all that it can currently be said to be doing. There is clearly enough here to warrant a properly powered health economic study.

Cognitive decline and osteoporotic fracture

■ Fragility fractures are of course the next major treatment problem in global orthopaedics. In fact, here at 360, we would go as far as to say that, along with obesity and

antibiotic resistance, fragility fracture and frailty represent the major healthcare challenge of the next century. There are numerous points at which these frail older patients come into contact with healthcare providers, and we are becoming more and more cognisant that the major problem is not the fragility fracture but the frailty. Investigators from **Osaka (Japan)** have investigated the effects of vertebral fracture and the association with cognitive decline.⁸ They collated information on 339 serial patients over the age of 65 years, all presenting with osteoporotic vertebral fractures, with a recent (two-month) history of back pain. Cognitive function was evaluated using the mini-mental state examination. Interestingly, the authors established that, in their sample of 339 patients (58 men and 281 women), cognitive decline was observed in 7.7% of them at the six-month follow-up. They observed that there was an association with delayed union (OR 4.7) and reduction in ability to perform ADLs. While this is an interesting observation, the conclusion the authors come to is curious. Rather than recognising an association, they go on to hypothesise that surgical treatment of the fragility fracture may halt the cognitive decline. This is in itself an odd assertion, and one we are somewhat at a loss to explain. It would seem to us at 360 that perhaps the observation that vertebral fractures are associated with a risk of cognitive decline and that use of appropriate fragility frailty screening and interventions would perhaps be most appropriate.

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Trauma

X-ref For other Roundups in this issue that cross-reference with Trauma see: *Foot & Ankle Roundups 1, 3 and 7; Hand & Wrist Roundup 6; Shoulder & Elbow Roundups 1, 2, 3 and 4; Oncology Roundup 1; Children's orthopaedics Roundup 1.*

Does ultrasound enhance fracture healing? X-ref

■ Anything that speeds up bone healing will be welcomed by patients and orthopaedic surgeons alike. The prospect of a simple device that offers a potentially believable

mechanism to improve bone healing through piezoelectric forces has, to a certain extent, captured the imagination of surgeons and patients. A group from **Canada, Norway and Switzerland** have undertaken a new systematic

review of the low-intensity pulsed ultrasound devices (LIPUS), and, given the 26 randomised studies of LIPUS which the authors were able to identify and include in their study, quite clearly this systematic review is long overdue.¹ The authors included