Injury, surgical timing, and the radial nerve in the humeral shaft X-ref

The management of humeral diaphyseal fractures remains a conundrum, with much of the literature supporting non-operative management originating from older studies, with some inherent methodological flaws, that have not been consistently reproducible.[1] A recent randomised trial reported favourable union rates following open reduction internal fixation (ORIF) when compared with non-operative management,[2] and a further recent study, discussed here at *360*, documented the rate of post-operative iatrogenic radial nerve palsy following nonunion surgery to be as high as 18.5%.[3] So, all that said, should we be fixing these fractures early and more frequently to avoid the risk of iatrogenic radial nerve palsy? In this retrospective review,[4] the upper limb research team in **Boston, Massachusetts (USA)** were able to report the outcomes of 325 patients, all of whom were included with a documented intact radial nerve function prior to surgery. The cohort included patients with either an acute fracture or humeral nonunion. The primary outcome measure was a post-operative iatrogenic radial nerve palsy. The mean age of the cohort at inclusion was 57 years (14 to 93). In terms of indications, 11.4% (n = 37) had undergone previous fixation, and 30.8% (n = 100) had an established nonunion. The patient cohort included a range of indications and there were 16.3% (n = 53) who underwent nailing (four combined with ORIF), while only 39.8% (n = 126) underwent intra-operative nerve exploration. The authors reported an overall iatrogenic radial nerve injury rate of 7.7% (n = 25). The take-home message for us here at *360* is that the time to surgery was not associated with injury, whether analysed as a continuous or binary variable. Of these 25 patients, 22 recovered fully with expectant treatment. One patient required nerve grafting, one required a tendon transfer, and one was lost to follow-up. On multivariate regression analysis, the authors report that the independent risk factors for iatrogenic radial nerve injury are distal third fracture location and previous fracture fixation. Despite the obvious limitations associated with a retrospective review, this study highlights important risk factors for developing an iatrogenic nerve injury. As we have discussed before, this neglected long-bone fracture requires more prospective data, and the results of large multicentre trials are awaited.

Acute, complete acromioclavicular joint dislocation: a randomised clinical trial X-ref

Despite being relatively common injuries, the management of the higher-grade acromioclavicular joint (ACJ) dislocation injuries remains controversial, with current evidence known to be inconclusive in terms of supporting either operative or non-operative treatments. There isn't even agreement on which is the best operation, let alone whether one should offer surgery or not.[5] This paper from **Toronto (Canada)**[6] is a further report from the first large contemporary randomised controlled trial (RCT) on the topic.[7] The authors report the general health status of a previously reported multicentre prospective RCT from the Canadian Orthopaedic Trauma Society (COTS) Group. The original study included 11 centres, and recruited and randomised 83 patients with an acute grade III to V dislocation of the ACJ to either surgery with a hook plate (n = 40) or non-operative management with a sling (n = 43). Patients were reviewed up to two years following injury for their final follow-up, and the primary outcome measures for this report were the physical and mental health components of the Short Form 36 Health Survey (SF-36) score at baseline, six weeks, three months, six months, one year, and two years post-injury. As with all trials, there was some significant longitudinal patient attrition; of the 83 patients enrolled, 58% in the non-operative arm and 63% in the operative arm were contactable and agreed to be reviewed at two years. The authors reported superior physical health scores in the non-operative group at three months but not at any other timepoint. Mental health scores were comparable at all timepoints. Perhaps unsurprisingly, given the active nature of patients who sustain these injuries, pre-injury physical and mental health scores were superior when compared with population normative data, but decreased to a level either below or comparable with the normative data following dislocation. Physical health scores, however, returned to above the normative at six months in the non-operative group, but not until two years for those patients who underwent surgery. The mental health scores, on the other hand, were generally quicker to recover in the surgical arm (six months conservative arm, three months surgical arm). As with the findings of the first publication from this study group, which demonstrated no difference in shoulder function between the two arms, this subsequent study has reported no general health difference between patients managed either non-operatively or with hook plate fixation for grade III to V dislocations of the ACJ. A caveat to this is the low number of grade IV and V injuries in this study (eight in the non-operative arm and three in the operative arm), thus limiting the conclusions to be drawn in those patients with this grade of injury.

Pre-operative doxycycline does not decolonise *Propionibacterium acnes* X-ref

Propionibacterium acnes is a common topic of discussion here at *360*, as it is the number one enemy for all shoulder surgeons. It is a common cause for indolent infection throughout shoulder surgery, including arthroplasty loosening, and has been implicated in clavicular nonunion, which was recently discussed in the August issue.[8] In this single-centre prospective randomised controlled trial (RCT), 74 male patients aged 18 years or older undergoing shoulder arthroscopy surgery were randomised to either oral doxycycline 100 mg twice a day for one week prior to surgery, or to standard care. To include only male patients could be debated at length methodologically, but it does not seem unreasonable given the recent evidence suggesting that males have a 66-fold increased rate of having a positive microbiological culture for subdermal colonisation.[9] The authors from **Philadelphia, Pennsylvania (USA)** chose the primary outcome measure of a positive culture from samples obtained prior to skin incision from two 3 mm punch biopsies from the anterior and posterior arthroscopic portal sites.[10] The authors conducted an initial power analysis, which determined that 74 patients were needed to get a clinically significant 35% decrease in positive culture rate. The groups were well matched at baseline. The authors found a higher (59.5% *vs* 43.2%), but not statistically significant (p = 0.245), incidence of at least one positive dermal culture in the standard care group. There was no significant difference in the incidence of one or two positive cultures between groups. Interestingly, there

was also a 20% *Propionibacterium acnes* sample rate in a separate negative control group of 20 consecutive sterile swabs that were opened in the operating room, wiped through the air and then sealed in a container. The authors acknowledge that their study could be underpowered, but, in this otherwise well-performed study, they conclude that they could not recommend routine administration of a one-week pre-operative prophylactic course of doxycycline to patients undergoing shoulder arthroscopy, particularly given the risks associated with antibiotic resistance. Although larger studies would be beneficial, one does wonder whether similar larger studies targeted at high-risk patients and high-risk procedures could result in a statistically significant reduction in positive culture rates, and hopefully a clinically meaningful improvement for the patient. The observation of a 20% false positive culture rate sets the cat further amongst the pigeons in the difficulties of interpreting the amassing data surrounding *Propionibacterium acnes*.

Arthroplasty for distal humeral fractures: a ten-year-minimum follow-up study X-ref

■ We recently discussed a paper here at *360* that documents a rising use of total elbow arthroplasty (TEA) for fractures of the distal humerus,[11] which, in all likelihood, is associated with the increasing number of elderly osteoporotic fractures. McKee et al[12] have, to date, provided the best Level I evidence with their multicentre prospective randomised controlled trial (RCT) that reported more predictable and superior functional results with TEA when compared with open reduction internal fixation (ORIF) in elderly osteoporotic patients. However, long-term data remain sparse, and concerns have been raised about changes in outcomes over a substantial follow-up period, as the natural history of arthroplasty is one of increasing failure rates, while the natural history of fixation is not. In this retrospective cohort study from **Rochester, Minnesota (USA)**,[13] the authors report the long-term outcomes of 44 patients who underwent TEA for the management of a distal humeral fracture over a total follow-up period of 24 years. All patients were managed with the linked semi-constrained Coonrad-Morrey Total Elbow (Zimmer Biomet, Warsaw, Indiana), and this of course is a designer surgeon series. Of the 44 original patients, 15 had concomitant rheumatoid arthritis (RA). The mean age of the patients at time of implantation was 71 years (38 to 93) and 75% were female. Outcome measures reported included survival, pain, range of movement, radiological appearance, and the Mayo Elbow Performance Score (MEPS). At the time of the study, 25 patients had died at a mean of 5.2 years (0.1 to 11) following the index procedure. Pain, flexion arc, and MEPS scores (mean 90.5 points) were all reported to be good, with no difference observed between those patients with and those without RA. Implant revision or removal was carried out in 18% of elbows (8/44). Indications for revision or removal were for infection, ulnar component loosening, or ulnar component fracture. The overall rate of deep infection was 11% and there were five additional periprosthetic fractures secondary to subsequent trauma. Survival for patients with RA was 85% at five years and 76% at ten years, and for those without RA it was 92% at both five and ten years. Here at *360*, we would agree with the conclusions of the authors of this study that TEA is a preferred treatment method when the complexity of the fracture means that stable fixation is not attainable in less active elderly patients and in those patients with concomitant inflammatory arthropathy. This study is important in that it adds significantly to what is already known on the topic. Surgeons can be increasingly confident that, in patients with complex fractures of the distal humerus, arthroplasty will yield a good and reasonably durable result, especially in patients without rheumatoid arthritis.

Shortening and outcome following non-operative management of clavicle fractures X-ref

■ The state of play with clavicle fractures increasingly seems to be in flux. With the range of randomised trials reported, each with different conclusions (although all showing roughly the same thing if you look at the results),[14,15] the dust seems to be settling to suggest that an increased rate of malunion is found following non-operative management of displaced midshaft clavicle fractures. However, the clinical importance of this finding is currently not quite clear – essentially, does malunion infer a clinically meaningful difference to the patient? In this interesting study from **Edinburgh (UK)**,[16] using data collected as part of their previously published multicentre trial comparing non-operative with operative treatment for midshaft clavicle fractures, the authors examined the impact of clavicular shortening, as measured with 3D CT, on the functional outcome and patient satisfaction in those with a united non-operatively managed displaced midshaft clavicle fracture. This study reports outcomes from the 105 patients from the original trial who were randomised to non-operative management. For the purposes of this study, following the exclusion of patients lost to follow-up, those who developed nonunion, and those who did not, had a 3D CT scan that included the entirety of both clavicles. This report is based essentially on 48 patients, all with non-operative treatment of their clavicle fractures. There was a mean relative shortening of the injured clavicle of 11.3 mm (SD 7.6), and a mean proportional shortening of 8% over the uninjured side. Perhaps more interesting in terms of outcomes, the authors were unable to establish any correlation between proportional shortening and the Disabilities of the Arm, Shoulder and Hand (DASH), Constant, or Short Form 12 Health Survey (SF-12) scores at any point during the study's one year of follow-up. When an artificial cut-off for shortening was established at 1 cm or 2 cm, again there were no significant differences found between the 'short' and 'non-short' subgroups in any outcome measure. Perhaps most importantly, there was no significant difference in the amount of clavicular shortening in those patients who were either satisfied or unsatisfied. A key strength of this study is the use of 3D CT, but, as the authors acknowledge, the findings in relation to the traditional cut-off of 2 cm of shortening are limited due to the small numbers of patients in this group (n = 5). Although the findings of this work should be interpreted in the context of malunion and not nonunion, this study offers excellent prognostic data for both the patient and surgeon following the non-operative management of a displaced midshaft clavicle fracture that heals.

Early diagnosis improves outcome for Essex–Lopresti injuries of the forearm X-ref

■ The Essex–Lopresti injury of the forearm is a rare but devastating injury that can often be subject to delayed diagnosis. With often unclear radiographs, no clear-cut findings on examination, and few clinicians with much experience in treatment, the diagnosis is not always clear. This is evident, not just in clinical practice, but also from the literature, and some of the larger case series report on the delayed management of this injury.[17,18] The aim of this retrospective single-centre case series from **Heidelberg (Germany)** was to detail the mid- to long-term outcome of 31 patients with an early (n = 16) or late (n = 15) diagnosis of an Essex-Lopresti lesion.[19] The cut-off point used for diagnosis of a delayed

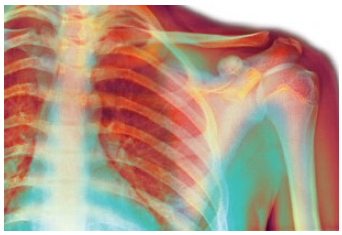
injury in this series was four weeks following injury. The patients were all retrospectively reviewed for the purposes of the study at a minimum of two years following injury (mean 5.3 years), using a combination of clinical and radiological outcomes, including patient-reported outcome measures (PROMs), such as the Mayo Elbow Performance Score (MEPS), Mayo Wrist Score (MWS), Visual Analog Scale (VAS) for wrist and elbow pain, and the Disabilities of the Arm, Shoulder and Hand (DASH) score. The authors established that, despite no significant differences apparent in the objective measurement of outcomes (including range of movement at the elbow or wrist), patients with a late diagnosis had a significantly poorer performance on PROMs and VAS scores, and a significantly increased rate of complications and revision surgery compared with the early diagnosis group (93% *vs* 38%). No objective differences in the rates of radiological osteoarthritis (OA) or radial shortening were reported. Despite the inevitable limitations associated with a retrospective case series of this nature, this is one of the largest series in the literature on this topic and the authors have presented much-needed mid- to long-term outcomes. As the authors conclude, it is apparent that, with an early diagnosis of the injury and appropriate management, satisfactory results can be attained. The findings of this study are consistent with those of a recent case series published in *The Bone & Joint Journal*.[20]

Non-operative management for terrible triad injuries of the elbow: is it possible? X-ref

■ Surgical management has been recommended for terrible triad fracture dislocations of the elbow since the early work by Regan and Morrey[21] both classified and pointed out the potential for instability and stiffness. The results of surgery have improved since the well-cited surgical protocol on how to manage these injuries was put forward by the team in Toronto, Canada.[22] Given the status quo is to default to an operation, we have been interested in the various recent small case series documenting positive results when non-operative management is employed in selected patients. The criteria commonly used are a concentric elbow joint post-reduction, a partial radial head fracture that does not block forearm rotation, a Regan–Morrey type 1 or 2 coronoid fracture, and, within the first seven to ten days following injury, a stable active elbow flexion from a minimum of 30° of extension.[23-25] In this retrospective cases series from **Tehran (Iran)**,[26] ten patients (mean age 38 years, range 27 to 54) at a mean of 30.6 months following terrible triad injury of the elbow, who fit these specified criteria, were managed non-operatively. The criteria employed by the authors were similar – a congruent elbow joint following closed reduction, no surgical indication in relation to the coronoid or radial head fractures, no block in forearm rotation up to 60° in both directions, no intra-articular fragments, and a stable elbow joint with extension up to a minimum of 45°. Two patients had a Mason type 1 fracture and eight a Mason type 2; three coronoid fractures were a Regan–Morrey type 1, and seven were a Regan–Morrey type 2. The mean final Disabilities of the Arm, Shoulder and Hand (DASH) score was 4.76 and the mean Mayo Elbow Performance Score was 95, with no patients undergoing further surgery. In this small series, the authors report that two patients developed a painful click on forearm rotation and one patient an ulnar nerve paraesthesia but intervention was declined. Using strict criteria, this study adds to a growing body of work highlighting the role of non-operative management for selected terrible triad elbow injuries. However, here at *360* we would suggest that there should be a low threshold for Examination under Anaesthetic (EUA) +/- surgery if there is any concern regarding elbow stability or forearm rotation. It seems likely that these injuries, given their concentric reduction and partial radial head fractures, do not represent true terrible triad injuries. If in doubt, an EUA is clearly a reasonable option.

Is there a gender effect in reverse shoulder outcomes?

■ There are some clear differences between genders in cuff-deficient shoulders, and there are some data to suggest that, prior to reverse shoulder arthroplasty, female patients may have poorer pre-surgical outcome scores and higher pain scores than their male equivalents. It isn't quite clear why this might be, although it may be to do with differences in the pre-operative cuff arthropathy. Given the limited quality of existing data, here at *360* our eyes were caught by this investigation from **San Francisco, California (USA)** with the aim of establishing whether women truly do suffer from worse pre-operative disability and poorer outcomes.[27] These authors report the results of their prospective study to investigate the outcomes of patients who underwent reverse total shoulder arthroplasty. All 117 patients included in the study underwent reverse shoulder arthroplasty for indications of rotator cuff arthropathy or osteoarthritis in the presence of a rotator cuff tear at a single institution over a six-year period. Outcomes were assessed using range of movement, Visual Analog Scale (VAS), Short Form 12 Health Survey (SF-12), and the American Shoulder and Elbow Surgeons (ASES) scores pre-operatively, and at one- and two-year follow-ups. There were no differences in demographics or length of stay between the male and female groups. However, when controlling for patient variables, the male patients achieved better ASES scores and SF-12 Physical scores. There were no differences in other outcomes reported, including ASES pain scores, SF-12 Mental scores, and objective assessments of range of movement.



There are some important take-home messages from this paper. Although there are some differences in outcomes between male and female patients, it is clear that both benefit from pain control. We wonder here at *360* whether, given the reliance of the reverse shoulder on deltoid function, the differences seen are predominantly due to differences in deltoid strength between men and women.

Stem cells and dermal matrix for rotator cuff tears?

■ The holy grail of soft-tissue surgery is the regeneration of cartilage, muscle, ligament, or tendon with equivalent pre-injury or pre-degeneration tissue. We are somewhat spoilt in bony surgery, in that bone naturally heals without scarring or restriction in functional or mechanical properties. Perhaps the clearest example of this problem is in soft-tissue shoulder surgery, where surgeons and scientists have been grappling with the ultimate aim of regenerating rotator cuff through a variety of tissue engineering and stem cell techniques with, as yet, very little success. These authors from **Daejeon (South Korea)** have reported their own novel approach to the problem by using a combination of tissue engineering in the form of acellular dermal matrix (ADM) and stem cells to establish if a bridging repair can be effective in massive rotator cuff tears.[28] In this combination animal-and-human study, the team generated a 5 × 5 mm rotator cuff defect in 17 rabbits, and following repair with ADM with and without stem cells, the repair was tested for biomechanical integrity. In addition, histological and immunohistochemical analyses were undertaken. The authors also

included the results of 24 patients, all with a massive rotator cuff tear, who were treated with an ADM to establish a bridging repair. As far as the rabbit experiments went, the normal rotator cuff (287 N) and ADM with stem cells (217 N) showed similar loads to failure, while the ADM on its own achieved a tensile strength of just 170 N. Histologically, there were signs of normal cuff tendon forming in both the ADM group and ADM plus stem cell group. As for the clinical study, there were statistically significant improvements in the American Shoulder and Elbow Surgeons (ASES) scores (50 pre-operative *vs* 83 post-operative), which were matched by similar improvements in the University of California Los Angeles (UCLA) shoulder rating scale (17 to 30) and the Simple Shoulder Test (4 to 8). Although the clinical group clearly did not undergo any further surgery, routine follow-up included post-operative MRI scanning. There were no progressions apparent in fatty degeneration or muscle atrophy on the post-operative scans. However, there was a significant re-tear rate (similar to primary cuff repair) on MRI imaging of 21% (n = 5/24). It is heartening to see some high-quality basic science work being undertaken prior to human implantation studies in a rigorous and scientifically valid way. There does look to be some scope for the ADM either with or without stem cell augmentation. We look forward to further development and reports of the technique.

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Spine

X-ref *For other Roundups in this issue that cross-reference with Spine see: Oncology Roundup 5; Research Roundup 4.*

Is surgery needed in lumbar degenerative kyphosis?

Lumbar degenerative kyphosis (LDK) is affecting older adults with increasing frequency. Although it has always been a diagnosis that we've encountered in clinical practice, as the activities and expectations of older adults have risen exponentially over the past two decades we are now at a stage where treatment for symptomatic sagittal imbalance is increasingly sought. As with all spinal surgery, the key is establishing when to take the decision to operate. The evidence for surgical correction of LDK is poor, and so it is currently unknown whether surgery offers a better outcome than conservative management. Surgery generally requires a corrective osteotomy and, in some cases, still results in persisting symptoms. The decision to proceed to operation for these patients is difficult at the best of times. However, Goh et al,[1] who have conducted a cohort study of over 100 patients, have been able to show the relative successes of these two treatments. The authors from **South Korea** report a two-year prospective