

ROUNDUP³⁶⁰

Shoulder & Elbow

Allograft is biomechanically superior in large Hill-Sachs defects

■ The treatment of large engaging Hill-Sachs lesions remains controversial. While all agree that recurrent dislocation complicated by an engaging Hill-Sachs lesion requires surgical management, there is little agreement among surgeons or scientists as to which treatments are superior. We were delighted to read this cadaveric biomechanical study from researchers in **London (Canada)** who aimed to establish the relative biomechanical effects of remplissage, humeral head allograft (HHA) and partial resurfacing arthroplasty (PRA). The researchers designed a cadaveric study using a validated method on a shoulder simulator. Eight specimens had two Hill-Sachs lesions (30% and 45%) created, tested on the simulator, and then treated with one of the three operations. These were then retested. The outcome measures were stability and range of movement. The investigators found that all of the simulated defects engaged and dislocated. In all the specimens in which HHA and remplissage were performed the defects ceased to engage, however, the same was not true of the PRA where a little over half were still engaging. The repaired defects had a similar range of movement and were no stiffer than the native shoulders, but those specimens having undergone remplissage were between 74% and 207% stiffer. This was

statistically significant. Throughout the entire range of movement the remplissage was stiffer than the two repair strategies. The authors conclude that remplissage is the least satisfactory of the procedures as it universally limited range of movement and increased shoulder stiffness, whilst both defect repairs maintain range of movement. The results of the three currently widely employed strategies are not equivalent, although the HHA appears to have the most favourable results in this study.¹ Here at 360 this study has somewhat set the little grey cells ticking. It is unusual to have such different biomechanical results, while in clinical practice all three techniques are widely employed. The remplissage is most likely to differ in clinical practice and biomechanical studies. With a course of physiotherapy and in live soft-tissue, the range of movement is likely to be regained. Would this make a better or worse outcome? If the soft-tissues stretch out too much, perhaps there is a risk of re-engagement. If not, this may become the best procedure. This is definitely a case where the age-old conclusion of many biomechanical studies – further clinical research is required – could not be truer.

Glenoid bone loss in shoulder dislocators

■ Instability and bone loss is not an uncommon sequela of anterior shoulder dislocation. Accurate assessment of any associated bone loss is essential to guide treatment. The

literature suggests that the most common bony defect is an anterior-inferior defect in the glenoid. We have always struggled at 360 to accurately assess the volume of bone loss, especially given the variation in glenoid anatomy. Researchers from **Dallas (USA)** have come to our aid with a study defining a new technique to accurately define bone loss and provide a guide to treatment in patients with significant bone loss who may not be suitable for arthroscopic treatment. The authors highlight the difficulty in assessing in 2D glenoid surface area losses, meaning that specialised software and 3D CT reconstructions are often required. However, a single dimension ‘width’ measurement on an axial radiograph has some severe limitations in determining suitability for, and appropriateness of, various types of surgery. The authors describe an innovative ‘glenoid arc-angle’ method. They postulate that their ‘arc angle’ method correlates closely with surface area loss, but is significantly easier to measure using standard PACS tools, making it potentially useful when planning surgery for anterior instability.² At 360, we are not yet quite ready to move to using the ‘arc angle’ described, without some clinical or other outcome data to demonstrate its efficacy in accurately quantifying glenoid bone loss. We are, however, interested enough to start measuring it in our patients. We hope the authors will be keen enough on their own measure to follow this up with a clinical article.

Repairing irreparable cuff tears: a new perspective

■ What to do with the irreparable cuff tear is a difficult and ongoing debate. Solutions range from anterior deltoid retraining to debridement and mesh interposition, among other strategies. Arthropathic shoulders with little or no cuff function are probably symptomatic of a combination of degenerative changes, cuff tear and superior instability. An interesting cadaveric study carried out in **Osaka (Japan)** proposes that in cases of irreparable rotator cuff tears, stability of the humeral head can be achieved through an alternative form of patch grafting (traditional patch grafting is known to have a high failure rate). The research team designed a cadaveric study to examine alternative patch grafting techniques, hypothesising that the high failure rate is due to failure to address superior instability. The investigators used eight cadaveric shoulders on a custom shoulder rig and instrumented the cadavers such that superior translation, subacromial contact pressure and glenohumeral joint reaction force could be calculated. They simulated five different scenarios; intact cuff, supraspinatus division and with a patch graft to one of three locations (supraspinatus tendon, superior capsule or both). The researchers used a baseline of the intact shoulders and found that compared with an intact shoulder, dividing supraspinatus increased superior translation, subacromial contact pressure, and consequently

decreased glenohumeral joint reaction force. Patch grafting the supraspinatus partly stabilised the shoulder superiorly, and inclusion of the superior capsule patch graft completely stabilised the shoulder. All patch grafts corrected subacromial contact pressure but did not alter the glenohumeral joint force.³ The authors propose that, based on these results, patch graft surgery for massive rotator cuff tears may be far more effective if the graft is attached medially to the superior glenoid and laterally to the greater tuberosity to maximise superior stability of the humeral head. If their cadaveric results are translatable, and shown to be clinically effective over mid-term follow-up in clinical studies, this may become a standard technique. As it stands, even this cadaveric work offers a tantalising chance to offer symptom resolution in a difficult to treat group of patients.

Acromioclavicular joint injuries

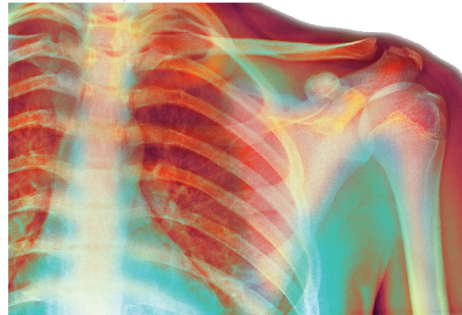
■ There are some studies which, although not revolutionary, are too significant to ignore, either due to sample size or findings. Researchers at **West Point (USA)** military academy have produced one such study describing the aetiology and natural history of acromioclavicular joint (ACJ) injuries by assessing an impressive 17 606 patient years over a four-year longitudinal cohort study. During the study period patients with a suspected ACJ injury underwent radiological and clinical examination. If an injury were present it was classified according to the Rockwood classification. Details of return to play, injury mechanism and athlete exposures were examined for risk factor analysis. The researchers identified 162 new ACJ injuries during 17 606 patient years documented within the study, giving an incidence of 9.2/1000 patient years. The vast majority of the injuries were low-grade injuries (89% grade I or II) with only 17% higher-grade injuries. Risk factor for ACJ injury were male gender (incidence ratio 2.18), and nine times

out of ten injuries occurred during athletic activities. Across the entire group of ACJ injuries, 1359 active days were lost, averaging 10.4 days/athlete for a low-grade sprain. This rose significantly to an average of 63.4 days lost for a high-grade injury. As would be expected, surgical intervention rates were much higher in the high-grade (grade III+) injuries, with over 70% requiring operative intervention.⁴ This study is the largest and most complete epidemiological study of ACJ injuries. Given the reputation of the West Point military academy for taking a high toll on their recruit's shoulders, we were pleasantly surprised to see how rare high grade injuries were in high risk patients.

More radiographs equals more surgery

■ The decision to treat a fracture of the clavicle is a difficult one to take. Balancing the risks and benefits of surgery can be hard enough in a straightforward fracture, but in an atypical fracture with much contradictory evidence it is often a nightmare to help guide the patient towards a sensible treatment plan. To make matters worse, different surgeons often make different decisions presented with the same patients and radiographs. Researchers in **Philadelphia (USA)** wanted to know if further radiological information would help improve decision making in a group of patients with a fracture of the clavicle. They developed a four-view radiological series which includes the standard AP and 20° cephalic tilt with the addition of two 45° tilted views to make a four-view series. The researchers designed a study to establish if the new series was helpful in the decision-making process. All four radiographs were obtained on 50 serial patients presenting with a fracture of the clavicle. Four independent, blinded

orthopaedic surgeons reviewed the x-rays both as a two- and four-view series, and were asked to indicate their treatment preference. The process was repeated two months later and the data correlated. In over a third of cases the addition of two further views changed the treatment plan; in the majority of these cases, this was to select an operative approach. There was significantly better intra-observer



reliability with the four-view series (0.76 versus 0.64), but no differences in the inter-observer reliability. The addition of further views improved the intra-observer reliability and also made surgeons more likely to treat operatively.⁵ Although the authors conclude that this is a positive effect, it may not be. It is reasonable to presume that additional views will likely show greater translation than the two views. However, the majority of evidence to support fixation of a fracture of the clavicle fractures is based on tightly-controlled randomised controlled trials where displacement was assessed on the standard views only. The operative benefit may not be as great for patients in whom the fracture looks sufficiently undisplaced on an AP view to be treated conservatively.

Reverse TSR may be cheaper than hemiarthroplasty

■ Cost-effectiveness analysis is one of the dark arts we, at 360 (like orthopaedic surgeons the world over), have become more and more familiar with. It is not enough for our treatments to simply work these days, they must work and be good value. This is bad news for innova-

tors, patients and pretty much everyone except those picking up the healthcare bill. However, health economics is not always bad: if a new treatment is significantly better, the increased costs will be offset by greatly improved function. Researchers in **Lebanon (USA)** set out to establish if the newer reverse shoulder replacements (RSR) were more or less cost-effective than humeral head replacements (HHR) in patients with advanced cuff arthropathy. The researchers designed a cost-effectiveness analysis, which took advantage of a sensitivity analysis, to establish what the drivers of the healthcare model were. The researchers used the current indexed literature to establish the outcome and complication probabilities, and costs were based on Medicare costs and reimbursement averages. The bar was set at a \$100 000 per QALY gained as the cost-effectiveness cut-off. The utilities were derived from SF-6D questionnaires completed by 31 patients undergoing either treatment in a single institution. The authors established that RSR could be a cost-effective option, but the model was sensitive to complication rate and implant price. In order for RSR to become a cost-effective treatment option the implant costs would have to drop below \$13 000 per implant.⁶ The data presented here, although all hypothetical, warrant a second look. With any luck this preliminary study will be spotted by one of our industry colleagues which may prompt a small price drop, or even better, a small price drop and a prospective head-to-head comparison study. Newer, better and more cost-effective implants? This seems to us at 360 like having your cake and eating it.

Autologous chondrocyte implantation makes it to the shoulder

■ The concept of autologous chondrocyte implantation is an excellent one: to harvest, culture and re-implant viable chondrocytes to promote healing of full thickness

chondral defects. The difficulty has been in obtaining reliable and convincing data that the two operations which require an expensive tissue culture facility actually result in a better clinical outcome than doing nothing at all. An innovative team of researchers from **Munich (Germany)** have designed a study to evaluate the potential application of this technology in young patients with focal chondral defects of the shoulder. They utilised an autologous chondrocyte transplantation process using collagen membrane seeding. The study team report a very early retrospective clinical series (Level IV evidence) of four consecutive male patients, all of whom underwent the procedure arthroscopically for treatment of symptomatic glenohumeral cartilage defects. Patients were assessed at a minimum of 24 months' follow-up with a range of outcome measures including radiological, pain score (visual analogue scale), functional scores (Constant, American Shoulder and Elbow Surgeons, Rowe) and a satisfaction index. Post-operative MRI scanning was undertaken to assess subsequent cartilage formation. The authors have treated three humeral and one glenoid lesion, all of which were full thickness and at least 2 cm² in size. All four patients had satisfactory post-operative scores (means: VAS 0.3; Constant 83.3; ASES 95.3),

and the post-operative MRI demonstrated satisfactory infill of the defect with fibrocartilage.⁷ The goalposts have moved significantly in the field of cartilage regeneration over the last few years. While originally the goal was the generation of hyaline cartilage, multiple-tissue studies have shown that, with the current techniques at least, this is unachievable and hyaline-like cartilage is the gold standard. These authors have demonstrated fibrocartilage infill of the defects. Many of you may be thinking fibrocartilage is achievable with microfracture (and here at 360 we would agree with you), but we are still delighted to see application of this technology with appropriate clinical follow-up. It seems likely to us that given time, biologics will become a commonplace treatment for this type of injury.

To operate or not? The fracture of the clavicle

■ The treatment of clavicular fractures is coming ever more under the spotlight. Following on from the Canadian Orthopaedic Trauma Association randomised controlled trial showing better performance with surgery, researchers in **Helsinki (Finland)** have designed their own randomised controlled trial (Level I evidence) to examine the potential treatment benefit of surgical *versus* non-surgical intervention. The researchers (after power analysis)

recruited 60 patients into their study (32 randomised to non-operative arm, and 28 to the operative group). Patients treated in the non-operative group were given a sling and physiotherapy, whilst those in the operative arm underwent surgical fixation with a 3.5 mm reconstruction plate. The researchers assessed outcomes using clinical scores (DASH, Constant), union rates, pain score and complications. In their study there was no difference between groups in function (Constant and DASH scores) or pain scores at one year of follow-up. Despite the equivalent shoulder function scores, the investigators found that 24% of the non-operative group developed a nonunion.⁸ There are two ways to look at this study; from one perspective, clavicular nonunion could well be asymptomatic in these patients, and consequently the results of the study are equivocal. From the other perspective, it may be that the outcome measures (although standard) selected by the authors are not sensitive to, or specific enough for, the clavicle. Here at 360 it seems most likely to be a combination of both factors. The authors of this study had broader inclusion criteria than the Canadian study. It may be that the Canadian study is not generalisable to a broader patient group. More thought and research is definitely required here.

REFERENCES

1. **Giles JW, Elkinson I, Ferreira LM, et al.** Moderate to large engaging Hill-Sachs defects: an in vitro biomechanical comparison of the remplissage procedure, allograft humeral head reconstruction, and partial resurfacing arthroplasty. *J Shoulder Elbow Surg* 2012;21:1142-1151.
2. **Dumont GD, Russell RD, Browne MG, Robertson WJ.** Area-based determination of bone loss using the glenoid arc angle. *Arthroscopy* 2012;28:1030-1035.
3. **Mihata T, McGarry MH, Pirolo JM, Kinoshita M, Lee TQ.** Superior capsule reconstruction to restore superior stability in irreparable rotator cuff tears: a biomechanical cadaveric study. *Am J Sports Med* 2012;40:2248-2255.
4. **Pallis M, Cameron KL, Svoboda SJ, Owens BD.** Epidemiology of acromioclavicular joint injury in young athletes. *Am J Sports Med* 2012;40:2072-2077.
5. **Austin LS, O'Brien MJ, Zmistowski B, et al.** Additional x-ray views increase decision to treat clavicular fractures surgically. *J Shoulder Elbow Surg* 2012;21:1263-1268.
6. **Coe MP, Greiwe RM, Joshi R, et al.** The cost-effectiveness of reverse total shoulder arthroplasty compared with hemiarthroplasty for rotator cuff tear arthropathy. *J Shoulder Elbow Surg* 2012;21:1278-1288.
7. **Buchmann S, Salzmann GM, Glanzmann MC, et al.** Early clinical and structural results after autologous chondrocyte transplantation at the glenohumeral joint. *J Shoulder Elbow Surg* 2012;21:1213-1221.
8. **Virtanen KJ, Remes V, Pajarinen J, et al.** Sling compared with plate osteosynthesis for treatment of displaced midshaft clavicular fractures: a randomized clinical trial. *J Bone Joint Surg [Am]* 2012;(Epub ahead of print) PMID: 22832887.