Rotator cuff tears in athletes

A rotator cuff tear in the athlete is different to the classic, more common cuff tear in the elderly. It is either a traumatic or an overhead, overuse injury in high functional demand patients, so it requires more active and earlier intervention, suspicion of injury, and specific assessment and treatment to enable return to the pre-injury level of sport.

The shoulder joint is composed of three articulations; the glenohumeral, the acromioclavicular and scapulothoracic joints (*Figure 1*). Of these, the glenohumeral joint comprises the 'ball-and-socket' element. Unlike its counterpart at the hip, its bony anatomy is inherently unstable, and relies on soft tissue structures for its stability.

The glenohumeral joint is surrounded by four tendons whose muscles arise from the scapula and insert onto the proximal humerus. The muscles comprise of supraspinatus superiorly, infraspinatus and teres minor posteriorly, and subscapularis anteriorly. Their muscle bellies arise separately, but the four tendons coalesce to form a cuff of tissue, named the rotator cuff (*Figure 2*). There is a discontinuity in the cuff between supraspinatus and subscapularis named the rotator interval. This allows the passage of the tendon of long head of biceps, which attaches via the labrum to the superior glenoid. The labrum itself is a cartilaginous 'washer' that surrounds the glenoid; it deepens the glenoid to provide greater stability, and provides attachment for the joint capsule.

Function and clinical testing of the rotator cuff

The rotator cuff has two main functions. First, it moves the shoulder at the glenohumeral joint. Second, it stabilizes the shoulder by surrounding the glenohumeral joint, and by coordinated action of the musculature to prevent abnormal positioning of the humerus on the glenoid (Arroyo et al, 1997). A 'rotator cuff tear' will almost always refer to a tear of the cuff tendon rather than the muscle belly. The tears can be either partial or full thickness.

Shoulder assessment should follow the classic look/feel/move routine. Particular attention should be directed towards looking for wasting in the supraspinatus and infraspinatus fossae (*Figure 3*). Scapular rhythm must be carefully assessed during shoulder movements. A full assessment of the cervical spine and neurovascular function is also necessary.

Supraspinatus assessment

Supraspinatus arises from the supraspinatus fossa of the scapula and inserts into the greater tuberosity. It contributes towards the initiation of shoulder abduction. Its integrity is determined by Jobe's test (*Figure 4*), in which the arm is forward flexed to 30° in the plane of the scapula with the thumbs pointing downwards. The examiner then places his/her hand over the deltoid and asks the patient to abduct against resistance. Pain and weakness are said to be indicative of a torn supraspinatus tendon. In the

Figure 1. Joints and bones comprising the shoulder complex.

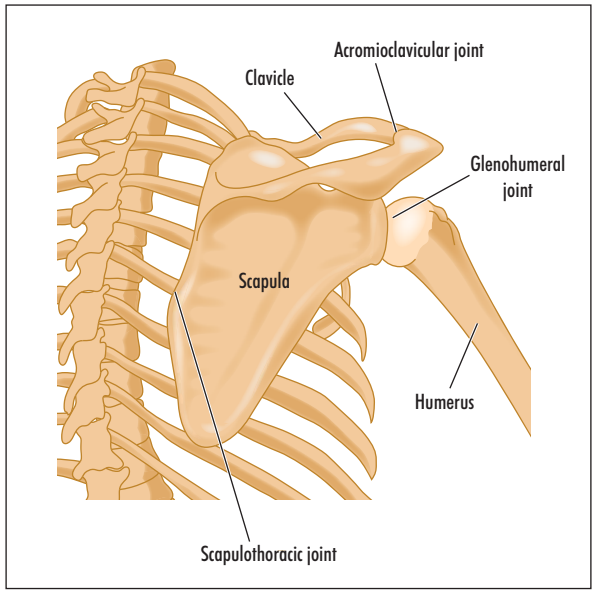
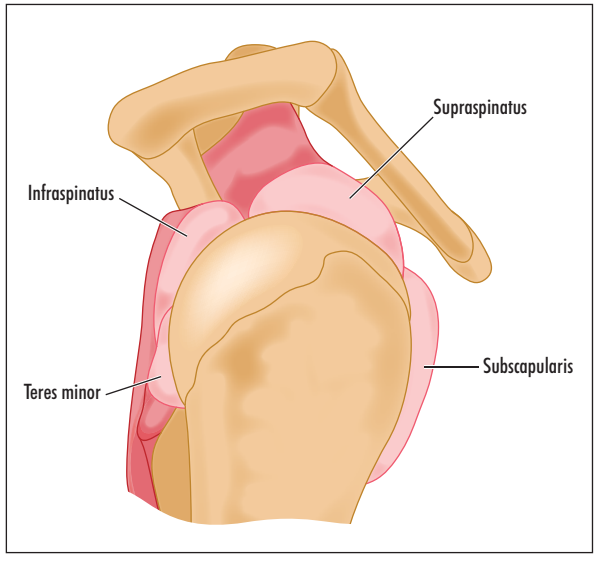


Figure 2. Rotator cuff tendons.



Mr Sunil Auplish *is Upper Limb Fellow and* **Professor Lennard Funk** *is Consultant Shoulder and Upper Limb Surgeon, Wrightington Hospital, Wigan WN6 9EP*

Correspondence to: Professor L Funk

case of a massive tear, the patient is unable to abduct the arm and can only shrug the shoulder (the 'shrug sign').

Infraspinatus assessment

Infraspinatus and teres minor arise from the infraspinatus fossa and lateral edge of the scapula respectively, and insert into the posterior greater tuberosity. They are responsible for external rotation. A tear should be suspected when external rotation is weak or painful against resistance (*Figure 5*). Its integrity is determined by the lag test, in which the patient is unable to actively maintain external rotation introduced by the examiner, and the arm flops back into internal rotation.

Subscapularis assessment

Subscapularis arises from the subscapularis fossa and inserts into the lesser tuberosity. It is responsible for internal rotation. Its integrity is best assessed by the 'bear hug' test, in which the patient places the palm of his/her hand on the anterior aspect of the opposite shoulder (*Figure 6*). The examiner then attempts to lift the patient's hand away from his/her body. Any pain or weakness suggests a subscapularis tendon tear.

Figure 3. Supraspinatus and infraspinatus muscle wasting of the left shoulder.

Figure 4. Supraspinatus strength test – Jobe's test.

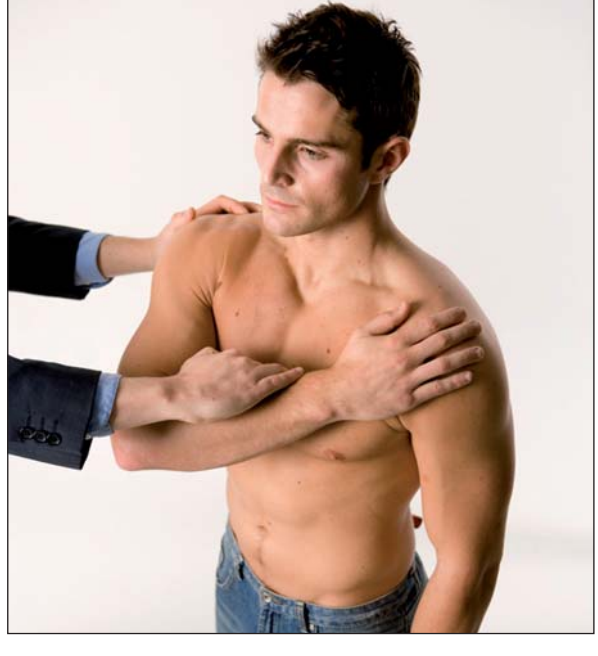
Investigations

Plain X-rays are useful to evaluate bony injury, including a rotator cuff avulsion fracture. Subluxation or frank dislocation may be seen, as well as other signs of instability such as a bony Bankart or Hill–Sachs lesion.

Ultrasound is a cheap and non-invasive method of investigating a rotator cuff tear. Office ultrasound is

Figure 5. Infraspinatus strength test.

Figure 6. Bear hug test for subscapularis.



gaining increasing popularity as an extension to the clinical examination. It is able to provide a dynamic assessment of cuff integrity and the best method for diagnosing rotator cuff pathology. However, it does require a suitably skilled and trained sonographer (Al-Shawi et al, 2008).

Magnetic resonance imaging arthrography is useful to evaluate concomitant shoulder injuries such as labral tear, which are often associated with cuff pathology in the athlete (Stetson et al, 2005; Funk and Snow, 2007).

Arthroscopy remains the gold standard investigation, allowing a direct inspection and repair of torn structures in the shoulder joint (*Figure 7*).

Rotator cuff tear in the non-athlete

Rotator cuff tears are very common in the elderly population, even in the asymptomatic shoulder (Sher et al, 1995). These are degenerative tears and may be complicated by a traumatic component following a minor injury, such as a fall or wrenching injury.

These tears are common, particularly in supraspinatus. The degenerative component is believed to be either a result of internal degeneration or longstanding impingement. It is treated initially by non-operative measures such as physiotherapy and steroid injection, and if this is unsuccessful by rotator cuff repair and/or sub-acromial decompression. There is still some controversy as to when and whether to repair a chronic rotator cuff tear in an elderly patient. However, a traumatic cuff tear in a functionally high demand and active patient, with weakness and pain, is best treated with a surgical repair.

Rotator cuff tears in the athlete

Full thickness tears of the young rotator cuff are rare, and seen more commonly in middle-aged athletes (Burkhart and Klein, 2004). The rotator cuff in younger people is very strong and more pliable than the elderly. Therefore, a large force is required to tear the cuff, which may also result in surrounding bony and soft tissue injury.

Alternatively the tear may represent a chronic cuff failure over time as a result of a mechanism of injury specific to that particular sport. This is mainly seen in overhead athletes.

Cuff pathology in the young athletic cuff must therefore be considered to be a different entity from impingement or cuff tear of the older cuff. There are three common types of athletic injuries of the rotator cuff.

Acute traumatic cuff tears from direct injury

Although rare, direct injury to the rotator cuff has been described in young athletes. Blevins et al (1996) described two cuff contusions, three full thickness tears, and five partial thickness cuff tears in ten American football players aged between 24 and 36 years of age. All patients experienced continued pain and dysfunction of the shoulder despite non-operative treatment involving rest, analgesia and physical therapy. Following surgical debridement or repair, nine of the ten patients returned to playing football. Despite its rarity, a rotator cuff tear should be suspected in a young athlete whose symptoms fail to improve after non-operative therapy for direct shoulder trauma. Burkhart and Klein (2004) described an arthroscopic double row repair technique for this injury, and stated their preference for this form of treatment. The second author has also presented his data on elite rugby players with traumatic rotator cuff tears (Funk and Badge, 2008). The injuries were mainly sustained during tackling and resulted in significant pain and weakness. All patients also underwent arthroscopic rotator cuff repair, followed by an accelerated rehabilitation programme.

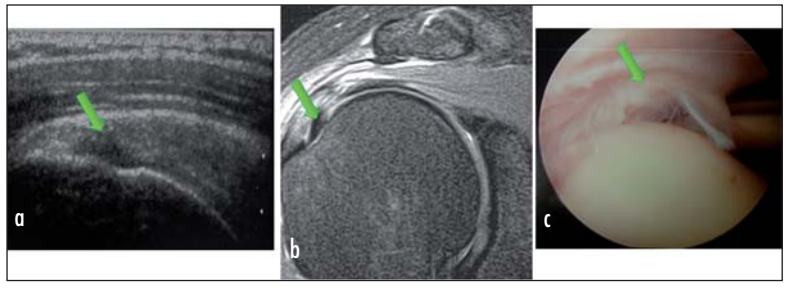
Rotator cuff tears associated with shoulder dislocation

Rotator cuff tear following shoulder dislocation is a common occurrence in the elderly, with 100% of patients in the over 70-year-old age group found to have a tear in one series (Simank et al, 2006). Reports of dislocation with associated cuff injury are rare in young athletes, but should always be considered following dislocation. Throckmorton and Albright (2001) described an 18-year-old who presented with loss of abduction and external rotation following an anterior dislocation in an American football game. He was found to have a 2 cm supraspinatus tear at arthroscopy, and received a mini-open cuff repair. The patient went on to full recovery at 1 year. Baker et al (1990) found that 12% of 28 unstable shoulders in patients under 30 years of age had a rotator cuff tear at arthroscopy after first anterior dislocation, but the size of tear, method and outcome of treatment are not stated.

Internal impingement and rotator cuff tear

Repetitive overhead sports which require excessive abduction and external rotation can lead to a condition known as internal impingement. This includes sports such as baseball, tennis, swimming and gymnastics. The greater tuberosity and postero-superior glenoid come into contact during the abduction/extension/external rotation manoeuvre of the cocking phase, trapping and abrading the rotator cuff (*Figure 8*) (Walch et al, 1992). An

Figure 7. Partial thickness rotator cuff tear (arrow) as seen on (a) ultrasound, (b) magnetic resonance imaging and (c) arthroscopy.



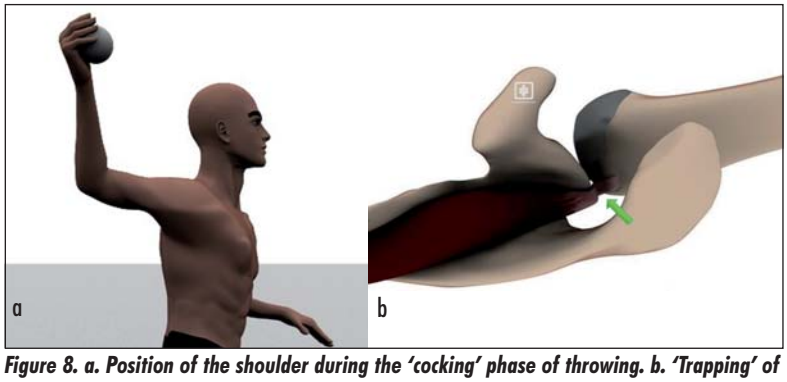


Figure 8. a. Position of the shoulder during the 'cocking' phase of throwing. b. 'Trapping' of the rotator cuff (arrowed) during the cocking phase.

extreme torsional force is also present in the cuff in this position (Burkhart, 2006). The rotator cuff in this area is prone to repetitive compressive and tensile trauma.

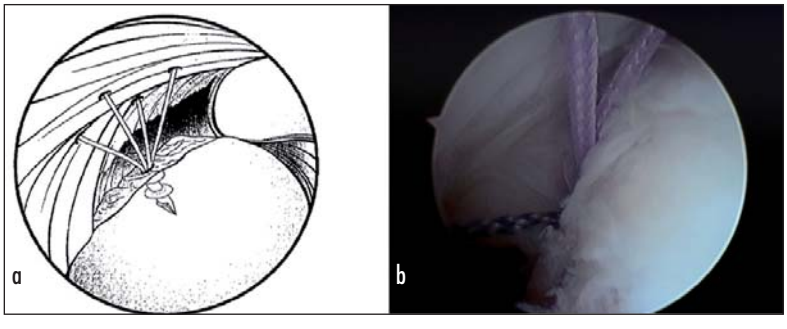
The pathological findings include a lax anterior capsule, a tight posterior capsule and an articular-sided partial thickness rotator cuff tear. These have been termed PASTA tears (partial articular supraspinatus tendon avulsion tears). In addition, a superior labral antero-posterior (SLAP) lesion may be produced as the biceps tendon is twisted and pulled off its origin at the superior glenoid.

Suspicion should be aroused in all overhead athletes complaining of shoulder pain. Jobe (1996) divided the clinical presentation into three stages; in stage I the athlete complains of difficulty in warming up, loss of velocity and control, but no pain. This was treated by 2 weeks rest and physical therapy directed towards the scapular rotators.

In stage II, pain is felt along the posterior joint line in the cocking phase of throwing. The patient also develops anterior capsular laxity and displays a positive relocation test. To perform this test, the patient lies flat with his/her arm in abduction, extension and external rotation. An anterior force on the humerus accentuates anterior instability and worsens the pain. A posterior force relieves the pain. This stage was treated by 4 weeks of rest with physical therapy. In addition, Burkhart (2006) recognized that posterior capsular contracture produced loss of internal rotation. He proposed posterior capsular stretching and cuff strengthening exercises (*Figure 9*). He also recognized pectoralis minor tightness and recommended stretching of this muscle as well.

Figure 9. Posterior capsular stretching for internal impingement.

Figure 10. a. Diagram of arthroscopic repair of PASTA (partial articular supraspinatus tendon avulsion) lesion before tying sutures to secure cuff back to bone (suture anchor in bone with sutures passed through torn cuff). b. Intraoperative photograph of PASTA lesion repair.



Stage III occurs with failure of treatment of stage II disease, and requires operative therapy. This involves debridement and repair of the rotator cuff tear, SLAP repair, posterior contracture release, and rotator interval or anterior capsule tightening.

Historically, initial results of partial and full thickness cuff repair in athletes were poor, with only 41% of patients returning to sport (Tibone et al, 1986). Advances in arthroscopic surgical techniques, and recognition and repair of concomitant injuries have led to much improved clinical results and early return to sports (*Figure 10*) (Burkhart and Klein, 2004; Funk and Badge, 2008).

The authors' results

The senior author treated 11 elite rugby players with full thickness rotator cuff injuries over a 26-month period. The mean age at presentation was 25.7 years. There was history of a specific traumatic episode in all cases, sustained during match play. The main presenting complaints were pain and weakness. None were able to return to rugby after injury. The injury to surgery interval was 5 weeks. At arthroscopy, cuff tears were small in three, moderate in five, large in two and massive in one patient. The mean width of the cuff tear was 1.8 cm. Associated injuries included two Bankart lesions, one posterior labral tear and two 360° labral tears. The biceps tendon was involved in three cases of which two were debrided and a tenodesis performed in one. Cuff repair was performed arthroscopically with suture anchors, and a supervised accelerated rehabilitation programme undertaken postoperatively.

The mean final follow up was 18 months (3–28 months). Constant shoulder scores improved from 44 preoperatively to 101 postoperatively and the Oxford shoulder score improved from 34 to 9. The mean time of return to full match play was 4.8 months. One player retired for other reasons. One patient required repeat arthroscopy at 5 weeks for continued weakness, but the repair was sound and he recovered fully. Two players had further injuries requiring surgery, where the cuff repair was seen to be intact. Postoperative scans in nine confirmed the repairs to be healed (Funk and Badge, 2008).

It was concluded that rotator cuff injury in the contact athlete can be addressed successfully by arthroscopic

technique. Arthroscopic cuff repair in this group gives good, reproducible results with high level of satisfaction from the demanding athlete.

Conclusions

Athletes can suffer both acute full thickness rotator cuff tears as a result of trauma, as well as chronic full and partial thickness tears as a result of overhead sports. The aetiology, assessment and treatment of these tears may bear little resemblance to the chronic tears so commonly seen in the elderly, sedentary population. Associated injuries in the shoulder must be assessed and managed concomitantly, as failure to treat all pathologies can lead to poor results in the athlete. Non-operative and operative treatment must be specifically directed at the underlying causes and pathologies to allow a return to sporting activity as soon as possible. **BJHM**

Conflict of interest: none.

Al-Shawi A, Badge R, Bunker T (2008) The detection of full thickness rotator cuff tears using ultrasound. *J Bone Joint Surg Br* **90**(7): 889–92

Arroyo JS, Hershon SJ, Bigliani LU (1997) Special considerations in the athletic throwing shoulder. *Orthop Clin North Am* **28**(1): 69–78

Baker CL, Uribe JW, Whitman C (1990) Arthroscopic evaluation of acute initial anterior shoulder dislocations. *Am J Sports Med* **18**(1): 25–8

Blevins FT, Hayes WM, Warren RF (1996) Rotator cuff injury in contact athletes. *Am J Sports Med* **24**(3): 263–7

Burkhart SS (2006) Internal impingement of the shoulder. *Instr Course Lect* **55:** 29–34

Burkhart SS, Klein JR (2004) Arthroscopic treatment of full-thickness rotator cuff repairs in the athlete. *Oper Tech Sports Med* **12:** 122–5

Funk L, Badge R (2008) Arthroscopic Rotator Cuff Repair in Elite Rugby Players. Presented at European Society of Shoulder and Elbow Surgery 2008, Brugge, Belgium, 17–20 September

Funk L, Snow M (2007) SLAP tears of the glenoid labrum in contact athletes. *Clin J Sport Med* **17**(1): 1–4

Jobe CM (1996) Superior glenoid impingement. Current concepts. *Clin Orthop Relat Res* **330:** 98–107

Sher JS, Uribe JW, Posada A, Murphy BJ, Zlatkin MB (1995) Abnormal findings on magnetic resonance images of asymptomatic shoulders. *J Bone Joint Surg Am* **77**(1): 10–15

Simank HG, Dauer G, Schneider S, Loew M (2006) Incidence of rotator cuff tears in shoulder dislocations and results of therapy in older patients. *Arch Orthop Trauma Surg* **126**(4): 235–40

Stetson WB, Phillips T, Deutsch A (2005) The use of magnetic resonance arthrography to detect partial-thickness rotator cuff tears. *J Bone Joint Surg Am* **87**(Suppl 2): 81–8

Throckmorton T, Albright J (2001) Case report: Concurrent anterior shoulder dislocation and rotator cuff tear in a young athlete. *Iowa Orthop J* **21:** 76–9

Tibone JE, Elrod B, Jobe FW et al (1986) Surgical treatment of tears of the rotator cuff in athletes. *J Bone Joint Surg Am* **68**(6): 887–91

Walch G, Boileau P, Noel E, Donell ST (1992) Impingement of the deep surface of the supraspinatus tendon on the posterosuperior glenoid rim: an arthroscopic study. *J Shoulder Elbow Surg* **1(5):** 238–45

KEY POINTS

- Rotator cuff tear in athletes may be traumatic as a result of contact sports or chronic as a result of repetitive overhead sports.
- Pain and weakness, with inability to return to play, should arise suspicion of a cuff tear.
- Ultrasound scan is the ideal investigation for diagnosing rotator cuff tears, but it is operator dependent.
- Associated glenohumeral lesions are common in athletes and best diagnosed with magnetic resonance arthrogram.
- Early, active intervention is essential for a rapid return to sports and all associated pathologies need to be addressed.