Surgical options for patients with shoulder pain

Salma Chaudhury, Stephen E. Gwilym, Jane Moser and Andrew J. Carr

Abstract | Shoulder pain is a common musculoskeletal complaint in the community, which can arise from diverse causes. Regardless of the cause, mild cases can often be effectively treated conservatively, with options including rest, physiotherapy, pain relief and glucocorticoid injections. If conservative strategies fail after a 3–6 month period then surgery might be considered. Generally, the proportion of patients with shoulder pain who require surgery is small. When surgery is considered, a clear diagnosis and structural information from imaging are required. The indications for surgery, and success rate, depend on the specific diagnosis as well as on the individual clinical presentation. Evidence from case series suggest that surgical interventions for shoulder pain are effective when used appropriately. This article outlines the surgical management of the most common painful conditions that affect the shoulder, including impingement, rotator cuff tear, frozen shoulder, osteoarthritis, rheumatoid arthritis and calcific tendonitis.

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Introduction

The prevalence of shoulder complaints in the UK is estimated to be 14%, with 1–2% of adults consulting their general practitioner annually regarding new-onset shoulder pain.[1] Rotator cuff pathology, including rotator cuff tears and impingement, reportedly accounts for up to 70% of shoulder pain problems.[2] Other common causes of shoulder pain include frozen shoulder, calcific tendonitis and osteoarthritis (OA).

Painful shoulders pose a substantial socioeconomic burden. Disability of the shoulder can impair ability to work or perform household tasks,[3] and can result in time off work.[4] Shoulder problems account for 2.4% of all general practitioner consultations in the UK,[5] and 4.5 million visits to physicians annually in the USA.[6] With the exception of fractures and traumatic rotator cuff tears, most shoulder pain problems are treated initially with conservative care. After 1 year of rest and conservative treatment, approximately 40% of patients will have persistent pain;[7] however, only between 8% and 41% of these patients are referred to a specialist.[5,8,9] In some patients with persistent symptoms, surgery might be required. More than 300,000 surgical repairs for rotator cuff pathologies (tears or impingement) are performed annually in the USA, and the annual financial burden of rotator cuff management in the USA has been estimated to be US$3 billion.[10] Rarely, pain can result from shoulder instability, particularly in younger people (under 30 years of age). The management of dislocations and recurrent shoulder instability is beyond the scope of this Review. This article outlines the surgical management of the most common painful conditions that affect the shoulder (Figure 1). For each condition we have considered the evidence for when surgery might be usefully employed, and the different surgical interventions available with consideration of both their limitations and their expected outcomes.

Competing interests
The authors declare no competing interests.

Initial management of shoulder pain

Diagnosis

The causes of shoulder pain are diverse. A thorough and relevant history is essential to determine the extent of shoulder pain and disability (Box 1). In conjunction with careful examination, this information should help to establish the etiology and enable the introduction of appropriate initial management (Figure 2). A few conditions require urgent referral to an orthopedic specialist and have been highlighted in Figure 2.

Imaging

The management of early, mild shoulder pain does not usually require any form of imaging, although a plain radiograph can help distinguish frozen shoulder from underlying OA. Arguably, a precise diagnosis and costly imaging of structural abnormalities are not required until symptoms have failed to settle with conservative management and when surgery is under consideration (Box 2). Plain radiography of the shoulder is a useful first-line investigation for shoulder pain and/or stiffness, as it can help identify bony abnormalities, arthritic and calcific changes and tumors. Radiography has limited diagnostic accuracy for soft tissue conditions. Ultrasonography is a cheap and rapid imaging modality, which is increasingly performed in outpatient clinics by either radiologists or trained surgeons as part of a 'one stop' clinic. Owing to its high accuracy, ultrasonography is useful in the detection of many soft-tissue pathologies of the shoulder.[11] With advances in technology, ultrasonography is increasingly used in clinics by orthopedic surgeons and rheumatologists with high levels of accuracy. CT is

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Key points

- Surgery for painful shoulder conditions is rare, but might be considered when conservative treatment fails and in the context of a clear diagnosis and structural information from imaging
- The benefit of surgery for frozen shoulder is unproven and most cases resolve with conservative treatment
- Arthroscopic subacromial decompression is commonly performed and can be effective for calcific tendonitis and impingement; acromial spur removal might not be necessary
- Rotator cuff repair relieves pain and improves function for symptomatic full-thickness tears, although 20–70% will re-rupture within 6 months; the role of surgery for partial-thickness tears is unclear
- Surgery for osteoarthritis associated with or resulting from massive rotator cuff tear is not effective at restoring motion, although pain relief can be satisfactory
- Joint replacement surgery for osteoarthritis and rheumatoid arthritis is effective for pain relief, but post-operative problems can arise from failure of the glenoid component

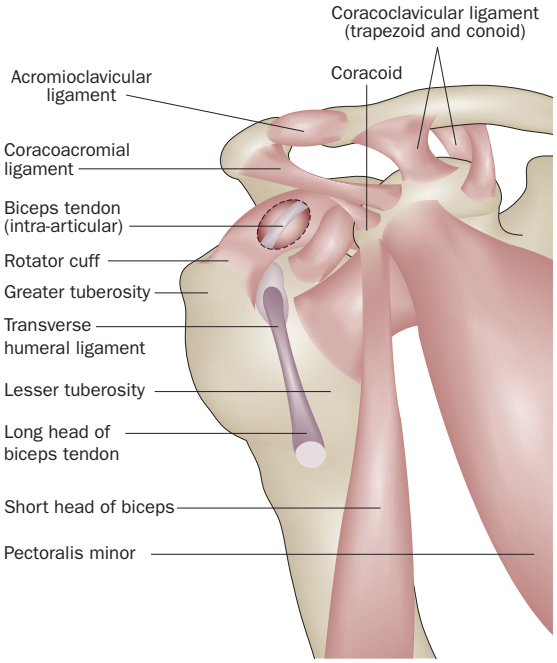

Figure 1 | Diagram showing the anatomy of a normal shoulder. Permission obtained from Elsevier Ltd © Carr, A. J. & Hamilton, W. *Orthopaedics in Primary Care* 2nd edn (2005).

excellent for diagnosing bony lesions and dislocations, but is limited in its ability to detect soft tissue lesions, particularly partial thickness tears, with the result that this technique is less frequently employed than radiography or ultrasonography. High accuracy in the detection of rotator cuff tears has been demonstrated with CT arthrography, which is usually more informative than a plain CT.[12] MRI is considered by many to be the investigation of choice, particularly for rotator cuff lesions, and some studies have suggested that MRI is a more accurate diagnostic tool than ultrasonography.[11,13] However, a meta-analysis of studies revealed that MRI and ultrasonography have comparable sensitivity and specificity for the diagnosis of both full-thickness and partial-thickness rotator cuff tears.[14] MRI arthrography is especially accurate for diagnosing conditions such as partial-thickness tears[15] and capsulolabral injuries. The disadvantages of MRI arthrography are the additional time and expertise required, higher cost and the need for an intra-articular injection with its rare, but unquantified, risk of joint infection.[16]

An important point to note is that the effectiveness of any imaging modality, particularly MRI, is reduced when the clinical picture and indications are unclear.[17,18] Owing to the high incidence of asymptomatic pathology and risk of both false-positive and false-negative results with any imaging modality, it is imperative to order investigations appropriately, with clear indications and when the results are expected to alter management.

Initial treatment

An initial period of conservative treatment is undertaken for most causes of mild-to-moderate and gradual-onset shoulder pain. Possible treatment options include rest, physiotherapy, pain relief and glucocorticoid injections (administered with or without local anesthetic). A Cochrane review of steroid injections for shoulder pain found that subacromial glucocorticoid injections showed short-term benefits over placebo in some trials, particularly for improving abduction.[19] However, glucocorticoid injections were not found to have any advantages over oral NSAIDs.[20] Repeated injections might be harmful and cause tissue and cellular damage that could result in tissue weakness, tendon rupture and impairment of healing.[21]

Surgical indications for shoulder pain

Indications for surgery usually involve sudden onset of severe symptoms and pathology, or a combination of failed conservative care, persistent or worsening pain, and functional disruption. The decision to operate should be supported by imaging findings that correspond with the clinical picture. The type of surgery employed will depend on the diagnosis, cause of pain and patient profile. In the following sections we describe the features of and indications for surgery in the most common painful shoulder conditions.

Frozen shoulder

Frozen shoulder is most common in patients aged 40–60 years and is slightly more frequent in women than men (1.5:1.0).[22] Patients with type 1 diabetes are at increased risk of this disorder.[23] The prevalence of frozen shoulder has been estimated at between 2% and 5%.[24,25] Frozen shoulder is essentially a clinical diagnosis, but plain radiography might be required to exclude glenohumeral OA. Codman[26] described diagnostic criteria in 1934 that include slow onset of shoulder pain at the deltoid insertion, an inability to sleep on the affected side, atrophy of the spinati muscles and localized tenderness. The details of the pathophysiological processes underlying this disease remain elusive; however, there seems to be a common pathway of inflammation and fibrosis

resulting in capsular contracture.[22] Frozen shoulder is generally regarded as a self-limiting condition,[27] and only rarely (in less than 5% of those presenting in secondary care) leads to long-term disability with restricted range of movement and persistent pain.[28] The natural history is usually described as passing through three stages: a 'freezing' or initial painful phase lasting up to 6 months, a 'frozen' or stiff phase of 6–18 months and a 'thawing' or recovery phase of 6–12 months.

Surgery for frozen shoulder is usually considered only after a period of failed conservative treatment in the frozen phase. The options for nonsurgical management of frozen shoulder have been the subject of multiple reviews and include physiotherapy, acupuncture, osteopathy, analgesics, NSAIDs, glucocorticoid injections and distension arthrography.[29,30]

Surgical interventions for frozen shoulder include manipulation under anesthesia (MUA)[31] and surgical capsular release.[32] Surgical release is usually focused on releasing the anteroinferior capsular structures. Capsular release can be performed in an open procedure or arthroscopically, and is often combined with MUA. The addition of capsular release aims to make the manipulation less traumatic and thus avoid complications (if performed before MUA) or to further optimize the range of movement obtained (if performed after MUA). The purpose of MUA is to address the directional limitations not addressed by release of the anteroinferior capsule. When timed appropriately, MUA substantially reduces pain and improves range-of-movement compared with pre-MUA levels.[22] Outcomes of arthroscopic capsular release are reported by some to be less successful in terms of pain relief and range-of-movement in patients with diabetes than in patients without diabetes.[33] Owing to the self-limiting nature of frozen shoulder, the key omission from current research is a lack of any control groups, which are needed to define the natural course of a condition during a trial period.

Impingement

Impingement is the most frequent cause of shoulder pain in the general population. An anatomical etiology has been proposed, whereby mechanical contact occurs between the rotator cuff tendons and the overlying acromion and coracohumeral ligament. Impingement and rotator cuff tears are associated with progressive change in shape of the acromion, with 'spurs' forming at its anteroinferior margin. These spurs are thought to narrow the subacromial space, thereby making physical contact between the rotator cuff tendons and bone more likely, particularly in certain positions of the arm (for example, painful arc),[34,35] and resulting in inflammation.

A high proportion of patients with impingement will respond to conservative treatment.[36] The most frequent indications for surgery are persistent and severe pain combined with functional restrictions that are resistant to conservative measures. Despite surgery being considered at this point, some reports show that surgery is no more effective than physiotherapy in the relief of pain when used in patients at this stage.[37,38] Surgical intervention does, however, achieve consistently good results and its judicious use seems valid.[39,40] The most common surgical intervention for impingement is subacromial decompression (SAD), which can be performed through an open (OSAD) or arthroscopic (ASAD) approach. A Cochrane review comparing the two approaches concluded that neither procedure has been shown to be superior to the other.[37,41] Long-term follow-up data on OSAD are limited, but published studies show that good short-term outcomes are achieved.[42] A randomized clinical trial comparing bursectomy alone with bursectomy plus ASAD revealed no difference in outcome at 2 years post-surgery.[43] This finding suggests that removing acromial spurs might not be necessary. In fact, a study by Hyvonen *et al.*[42] suggested that acromioplasty does not prevent the progression of impingement to rotator cuff tears. An assessment of the cost of treatment of impingement suggested that the addition of surgery, in comparison to exercise treatment alone, is not cost-effective.[44] Further research might identify whether the source of pain is the tendon, the acromion or the bursa, and hence help to rationalize surgical treatment.

Box 1 | History relevant to shoulder pain

- Hand dominance
- Occupation and level of activity or sports
- Location of pain
- Radiation of pain
- Onset of pain
- Exacerbating factors
- Relieving factors
- Use of analgesia
- History of trauma or instability
- Involvement of other joints
- Systemic illnesses or comorbidities

Rotator cuff tears

The term 'rotator cuff tear' refers to structural failure and tissue disruption in at least one of the four muscles and tendons that form the rotator cuff (Figure 3). Although the incidence of rotator cuff tears increases with increasing age, particularly over the age of 50 years,[45] not all tears are symptomatic.[46] The prevalence of asymptomatic tears in the general population is estimated to be between 5% and 30% and also increases with increasing age.[47] Although repair of rotator cuff tears is usually advocated for painful tears with functional impairment, some uncertainty exists as to exactly when to operate and what features should guide this decision. Higher rates of re-rupture are associated with larger tears,[48] increased patient age,[49] and increased fatty degeneration of the cuff muscles.[50] For degenerative tears, a trial of conservative care including exercise therapy can be considered,[51] as some patients are able to achieve good shoulder function despite a rotator cuff tear.[52]

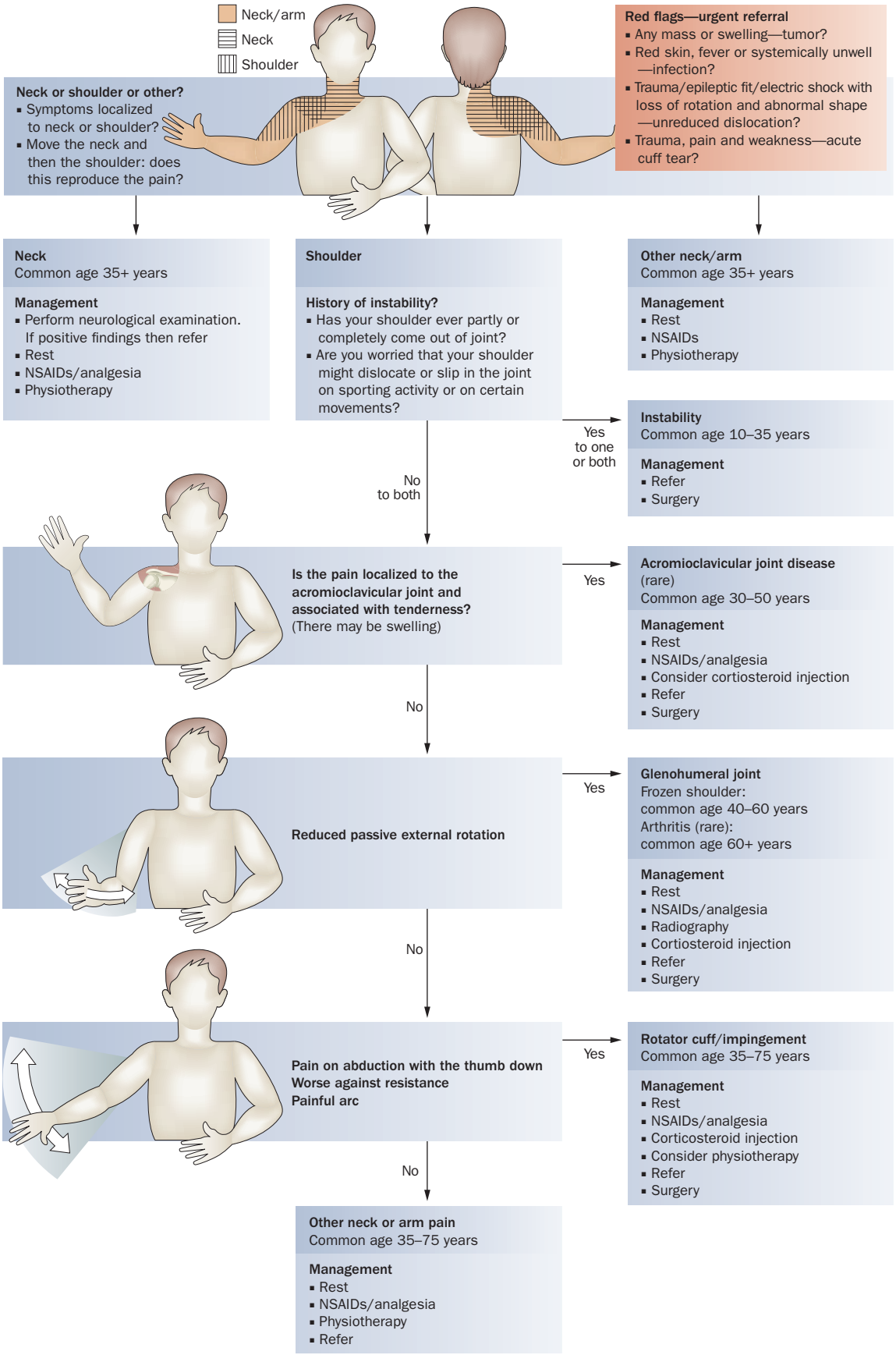

Figure 2 | Guidelines to assist with initial management of shoulder problems. Permission to reproduce figure obtained from A. Carr, University of Oxford, UK.

Rotator cuff tears can be repaired using a variety of techniques including arthroscopic repair, mini-open repair and open repair (all of which can be performed with or without SAD). Debridement is sometimes performed for both partial-thickness and massive tears. Open repairs are arguably technically easier to perform and enable better tissue mobilization and repair. The potential advantages of an arthroscopic approach are a smaller scar, decreased deltoid muscle trauma, less pain and morbidity, faster rehabilitation and earlier return to normal movement.[53] A study comparing arthroscopic versus open intervention found equivalent postoperative changes in outcome scores and rates of MRI-detected re-tear.[54] Simultaneous SAD during arthroscopic cuff repair has not been shown to alter the clinical outcome when compared with arthroscopic repairs alone.[55,56]

A mini-open repair is performed without deltoid detachment from the anterior acromion, and several authors have reported that approximately 90% of patients achieved good-to-excellent outcomes with this technique.[57,58] ASAD with mini-open repair is considered by many to be the open procedure of choice,[59] and is the method to which arthroscopic repairs are compared.[60] Pollock and Flatow[61] concluded that this technique was unsuitable for large rotator cuff tears with retraction or involvement of tendons other than the supraspinatus. Comparisons of arthroscopic and mini-open approaches found similar postoperative outcomes,[62,63] range of movement improvements and re-tear rates,[64] although Bishop *et al.*[60] reported that for larger tears mini-open repairs had approximately half the re-rupture rate of small tears.

High failure rates of 13–68% have been reported for surgical repair of rotator cuff tears[60,65] irrespective of the surgical technique employed.[66] Some studies have suggested that re-rupture rates are associated with poorer outcomes.[67] Rotator cuff tears associated with systemic diseases such as rheumatoid arthritis (RA) are an additional surgical challenge.[68] What is surprising is that, despite failure of the surgical repair, most patients report improved pain levels post-operation.[66,69] However, patients whose repairs remain intact do relatively better in terms of function[66] and strength,[70,71] but are no different in terms of pain scores than those who experience a re-rupture. This observation further emphasizes a lack of understanding of the mechanisms and source of pain in patients with shoulder pain.

Many symptomatic tears respond to nonsurgical management,[72] and some patients with tears demonstrate marked improvement following ASAD and rotator cuff debridement without cuff repair.[73] An argument in support of repairing tears is that without surgical intervention there is a significant likelihood of tear progression[74] and SAD alone does not reduce this risk.[42] In cases of massive tear where a complete repair is not possible, various strategies—including tendon transfers and incorporation of the biceps tendon—have been employed, but in the absence of any controlled data the effectiveness of these approaches is unclear.[75]

Box 2 | Imaging of shoulder pain

- Imaging is not generally required for the management of early, mild symptoms of shoulder pain
- Plain radiography of the shoulder can reveal bony abnormalities, calcific tendonitis, humeral head elevation in rotator cuff tears, glenohumeral joint arthritis, acromioclavicular joint arthritis, and avascular necrosis
- Frozen shoulder is essentially a clinical diagnosis, but plain radiography might be required to exclude glenohumeral osteoarthritis
- MRI, ultrasonography and CT should be undertaken only when surgical repair is being considered
- CT arthrography is usually a more informative investigation than plain CT
- An assessment of muscle atrophy and fatty degeneration using MRI, CT or ultrasonography can help plan rotator cuff repair surgery

The superiority of one surgical approach over another has not been proven.[76] This lack of evidence is reflected in the considerable variation in surgical opinion, decision making and treatment strategies used to manage rotator cuff tears.[77]

Partial-thickness rotator cuff tears

Any tear that involves rotator cuff disruption that does not extend all the way through the tendon is termed a 'partial-thickness tear' (PTT). PTTs are more prevalent that full-thickness tears.[78] Information is lacking regarding the risk of progression of PTTs to full-thickness tears. The management of PTTs is controversial and patients with PTTs have commonly been treated conservatively. If the symptoms fail to resolve with conservative treatment then SAD might be beneficial. Favorable results have been reported following debridement of PTT in association with SAD.[79]

Cordasco *et al.*[80] demonstrated that, for patients who underwent arthroscopic acromioplasty and debridement, lesions involving less than 50% of the thickness of the cuff are at risk of progression in the long term. PTT involving more than 50% of the tendon depth achieved good outcomes following open repair but no controls were studied.[81] This distinction could offer guidance as to when to operate, but more evidence with well-designed trials is required. A recent trend is to repair partial tears arthroscopically, either by conversion to a full thickness tear and subsequent repair, or with a transtendon repair. The former has been shown to improve clinical outcome scores and pain in the short-term with high rates of patient satisfaction,[82] and one series has suggested that outcomes for arthroscopic repairs of PTTs are comparable to those for full-thickness tears.[83]

Irreparable rotator cuff tears

Tears are deemed irreparable when it is impossible to reconnect the tendon to its insertion footprint without unacceptable degrees of tension, or when poor tendon

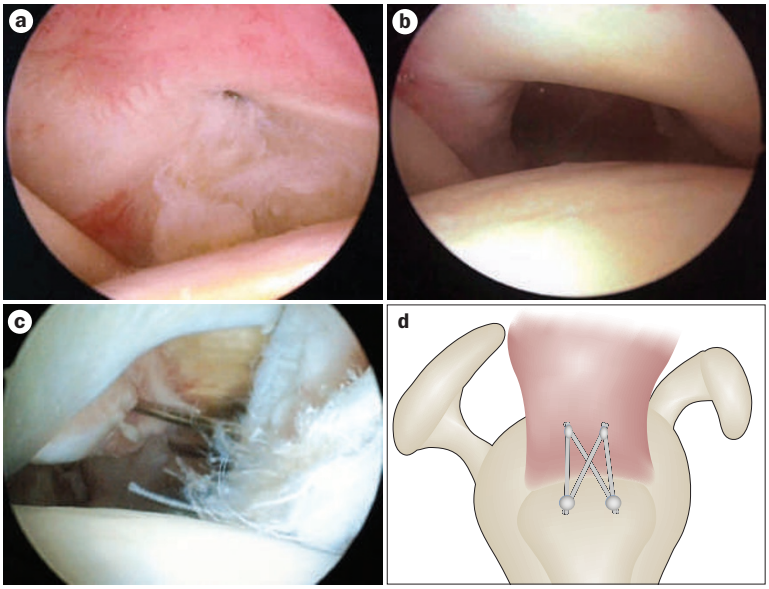

Figure 3 | Appearance and repair of rotator cuff tears. **a** | Partial-thickness rotator cuff tear of the joint surface. **b** | A medium-sized tear. **c** | A large tear with detachment of the anterior supraspinatus tendon and fraying of the long head of the biceps. **d** | Schematic of a repair that uses a double-row of suture anchors to reattach the rotator cuff tendons to the 'footprint' of the greater tubercle of the humerus.

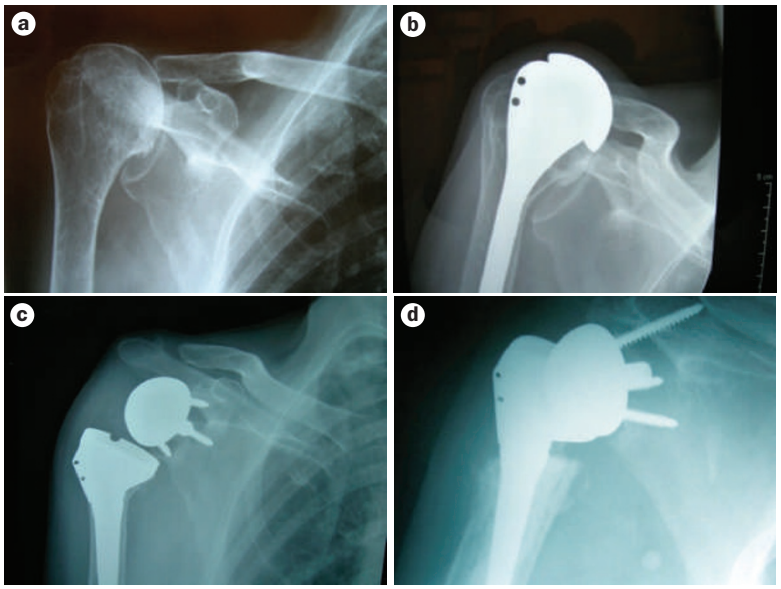

Figure 4 | Management of a patient with a massive rotator cuff tear. **a** | Radiograph showing anterosuperior migration of the humeral head and arthritic changes of the glenohumeral joint. **b** | Radiograph showing treatment with hemiarthroplasty, with persistent anterosuperior migration. **c** | Radiograph showing implant revision to reverse total shoulder arthroplasty. **d** | Radiograph showing failure of the reverse total shoulder arthroplasty with dislocation.

quality prevents purchase of a suture. Goutallier *et al.*[50] demonstrated that fatty degeneration of the infraspinatus or subscapularis muscles is associated with less-favorable outcomes after repair. An assessment of muscle atrophy and fatty degeneration using MRI, CT or ultrasonography could help plan rotator cuff repair surgery. Debridement and SAD have been reported to improve outcomes of pain, function, and patient satisfaction.[84,85] A comparison of debridement and attempted surgical repair found that debridement resulted in a worse outcome, with only an 8% satisfaction rate compared with 87% for repair, but this was not a randomized or controlled study.[86] Although latissimus dorsi transfers to the humeral head have been reported to improve external rotation and assist deltoid function,[87] series have reported mixed outcomes with this procedure,[88,89] and tendon transfers are not widely undertaken. An improvement in shoulder pain and dysfunction has been demonstrated in retrospective studies of irreparable massive rotator cuff tears treated with biceps tenotomy[90] or tenodesis.[91]

Cuff tear arthropathy

Neer and colleagues[92] coined the term 'cuff tear arthropathy' in 1983 to describe severe rotator cuff tendon insufficiency associated with arthritic changes of the glenohumeral joint. Many surgical interventions for this condition are palliative. Both hemiarthroplasty and total shoulder arthroplasty (TSA) are successful treatment options for cuff tear arthropathy,[93] and the advantages and disadvantages of each procedure need to be considered during preoperative planning (Figure 4). TSA is liable to be complicated by glenoid loosening and can only be performed in patients with adequate glenoid bone stock.[94] Hemiarthroplasty is technically easier and less invasive to perform than TSA but can be associated with glenoid erosion.[95,96] SAD is not recommended for cuff tear arthropathy because anterosuperior migration of the humeral head might be accelerated by the procedure. Some shoulder replacements, such as reverse TSA or linked shoulder replacement, aim to restore the kinematics of the glenohumeral joint by forcing the center of rotation to move inferiorly despite the loss of the rotator cuff muscles.[97] Such implants are recommended only in low-functional-demand patients over the age of 70 years owing to the high risk of implant loosening and failure.[98] Reports describe improved active elevation and outcome scores[99] with good 10-year survival rates,[98] but these and other studies also reveal higher complication rates than reported after minimally constrained TSA,[100] and some concerns remain about complications including inferior scapular notching and glenoid loosening. Although tuberoplasty has been used to treat cuff tear arthropathy with reported improvements in pain relief[101] and clinical scores,[102] no wide body of evidence supports the use of this procedure and it is rarely performed. Other surgical interventions include debridement, tenotomy of the long head of biceps, and arthrodesis; no strong evidence supports the effectiveness of these less-commonly applied procedures.

Calcific tendonitis

Pain associated with calcific tendonitis can be of acute or insidious onset and is associated with deposition of calcium hydroxyapatite within rotator cuff tendons, most commonly the supraspinatus tendons. Calcific tendonitis

can be detected by plain radiography. In addition to the conservative measures normally applied to shoulder complaints, a number of interventional but nonsurgical options are available for the treatment of calcific tendonitis. These interventions include extracorporeal shockwave therapy and needling or barbotage. A number of uncontrolled case series have produced positive reports, but none of these interventions has been thoroughly compared with surgery.[103,104] In the long term, barbotage might be no more effective for pain relief than no treatment, despite providing substantial pain relief in the first year.[105]

Surgical debridement of the calcific deposit for symptoms that persist after nonoperative treatment has been reported to produce considerable pain relief and improved function in single-treatment case series.[106,107] Surgical intervention could be particularly suitable when a mixed pathology (for example, impingement and calcific deposit) is suspected.[108]

Acromioclavicular joint pain

The acromioclavicular joint can be affected by a number of painful conditions, including primary OA, secondary (post-traumatic) OA (with or without associated subluxation) and distal clavicle osteolysis. The primary indication for surgery is localized pain of more than 6 months' duration that persists despite conservative management. The primary aim of surgery is resection of the distal end of the clavicle whilst maintaining joint stability through preservation of the joint capsule and superior acromioclavicular ligament. This can be achieved through open or arthroscopic methods, and most case series report patient satisfaction exceeding 90% with high levels of 'good-to-excellent' results.[109–111]

Glenohumeral joint osteoarthritis

Shoulder OA is relatively rare, both compared with the frequency of hip and knee OA and as a proportion of patients who present with shoulder pain. Glenohumeral OA is typically associated with a globally decreased range of movement, pain and radiological signs of degeneration. In glenohumeral joint OA there are broadly three possible combinations of joint and tendon disruption, albeit with indistinct boundaries: primary glenohumeral joint OA with or without an intact rotator cuff, and OA secondary to a massive rotator cuff tear (termed cuff tear arthropathy, the treatment of which was discussed previously).

Conservative treatment aims to reduce inflammation (for example, by administration of NSAIDs and intra-articular steroids), and increase joint stability and decrease joint reaction force through activity-modification and physiotherapy. Indications for surgery include pain and functional restriction. Surgical options include arthroscopic wash-out, debridement and joint replacement. Arthroscopic debridement has been advocated in case series,[112] but no comparative studies have assessed the efficacy of this treatment. In addition, its indication might be limited to younger patients wishing to defer arthroplasty and patients unsuitable for arthroplasty.[113] Arthroplasty, including hemiarthroplasty, TSA and resurfacing arthroplasty, is well established as an effective means of improving both pain and function (Figure 5).[94] The choice of prosthesis type (for example, surface or stemmed, total or hemi, cemented or uncemented) is a matter of debate, with some studies finding more favorable results for TSA (with glenoid replacement) than replacement of the humerus alone (with or without micro-fracture or biological resurfacing of the glenoid).[114–117] Some reports highlight the high rates of glenoid component loosening following TSA, in comparison with the good-to-excellent 5-to-10 year results of hemiarthroplasty, which avoids the potential complication of glenoid loosening. Future work will have to directly and prospectively compare these procedures, preferably in randomized clinical trials.

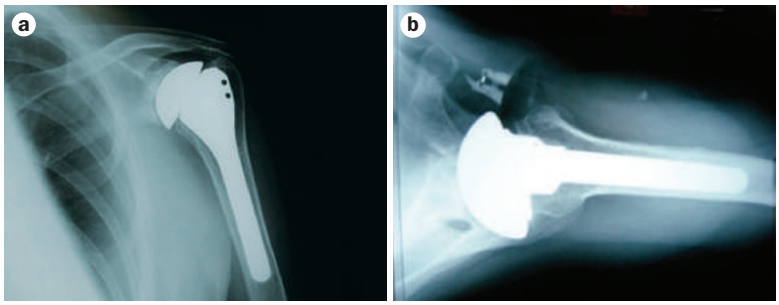

Figure 5 | Shoulder replacement surgery for a patient with osteoarthritis of the shoulder joint. **a** | Radiograph of successful hemiarthroplasty showing that the relationship of the glenoid and humerus are well maintained. **b** | Radiograph of failed total shoulder replacement showing loosening and dislocation of the glenoid component.

The presence or absence of a small rotator cuff tear does not seem to influence the outcome of arthroplasty[119] and, indeed, outcomes following hemiarthroplasty in the presence of massive cuff tears have been shown to produce significant benefits, especially in patients with pre-operative forward flexion greater than 90°.[97]

Glenohumeral joint rheumatoid arthritis

The multidisciplinary team involved in the care of the patient with RA must decide on the need for, and timing of, surgical intervention for painful shoulder disease, which is reported to occur in 65–90% of patients with RA.[120] As in other joints, the primary surgical options are synovectomy (open or arthroscopic) and joint replacement.[121] Arthrodesis of the shoulder is rarely indicated. Synovectomy was previously employed as a pain relieving procedure with reported success,[122] but modern DMARDs and biological therapies have made the use of this procedure rare in contemporary practice.

The outcome of shoulder arthroplasty in patients with RA is comparable to that in patients undergoing arthroplasty for OA: 69–85% 10-year survival rates are reported.[121] The design and type of implant does not appear to influence outcome, but resurfacing is not appropriate when severe joint destruction renders the humeral head too small or soft.[123]

Conclusions

Overall, the need for surgery in the management of shoulder pain is rare. However, evidence from case series supports the effectiveness of surgical interventions for shoulder pain when used appropriately. Specifically, favorable outcomes have been reported for SAD for impingement, repair for cuff tear, MUA and capsular release for frozen shoulder, distal clavicle excision for OA of the acromioclavicular joint, excision of the calcific deposit in calcific tendonitis and joint replacement for glenohumeral joint OA and RA. Further improvements in the design of implants, refinements in surgical techniques and adjunctive use of biological therapies aimed at both tissue augmentation and pain reduction could further improve outcomes.

Review criteria

Full text articles published in English were identified in August 2009 by searching Medline CINAHL AMED, the Cochrane library, Embase and the Web of Science for all available systematic reviews and other publications. No restrictions were placed on date of publication. Keywords used included: "shoulder"; "pain"; "frozen shoulder"; "impingement"; "rotator cuff"; "tear"; "irreparable"; "arthropathy"; "partial thickness"; "calcific"; "tendonitis"; "surgery"; "repair"; "arthroscopy"; "arthroscopic"; "acromioplasty"; "hemiarthroplasty"; "glenohumeral"; "acromioclavicular"; "supraspinatus"; "rheumatoid; arthritis"; "osteoarthritis"; and "joint". Keywords were used separately or in combination; truncation was used where possible.

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