

Rotator Cuff Tears: Pathology and Nonsurgical Management

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Abstract

Rotator cuff tears may be caused by intrinsic (biochemical) or extrinsic (physical) mechanisms. They may also be classified as traumatic (acute) or non-traumatic (sub-acute). Due to an on-going lack of literature on natural history and disease progression, a variety of treatment approaches to manage these tears exists and as such consensus views can fluctuate. This article will focus on the anatomy of the rotator cuff and pathology that may affect it, before discussing the non-operative approaches commonly used. A potential algorithm for management is proposed, highlighting the timings to consider for surgical intervention.

Keywords: rotator cuff disease, conservative management, physiotherapy, corticosteroid injection, pathology

Introduction

Rotator cuff tears are a common condition seen in primary and secondary care. Management of such conditions varies greatly between clinicians of differing specialities and even varies among surgeons. Due to incomplete scientific evidence, decisions are made based on existing knowledge and personal experience. In this review we aim to highlight some of the non-surgical options for management of rotator cuff tears.

Anatomy of the Rotator Cuff¹

The rotator cuff is made up of four muscles whose principle functions are to stabilise the humeral head in the glenoid, as well as allowing for some movement at the glenohumeral joint.

Four layers surround the glenohumeral joint. The most superficial layer consists of the deltoid and pectoralis muscles. The second layer is formed by a number of non-muscular structures: the clavipectoral fascia, which extends from the undersurface of the clavicle, surrounds pectoralis minor and attaches to the axillary fascia; the conjoint tendon of the short head of the biceps and coracobrachialis; and the coracoacromial ligament extending from the lateral coracoid to the lateral acromion. The third layer consists of the rotator cuff, discussed in more detail below, whilst the deepest layer is the glenohumeral joint capsule and the 'ligaments' this structure forms.

The rotator cuff consists of four muscles; supraspinatus, infraspinatus, subscapularis and teres minor. Each muscle of the rotator cuff originates from the scapula and has a tendon that attaches to one of the tuberosities of the humeral head. The tendons together form an incomplete cuff around the humeral head. It is incomplete as the tendons are required to separate around two anatomical structures: the coracoid and the long head of the biceps tendon.

The insertion and orientation of the rotator cuff tendons onto the proximal humerus is of prime importance when conceptualizing rotator cuff tears.

For this description, we will use the clock-face analogy of rotator cuff insertion points, looking from the lateral side of the left shoulder with the arm in the anatomical position (Figure 1). The area from 11 o'clock to 5 o'clock can be seen to have a confluent attachment, along the superior and posterior length of the greater tuberosity. From 7 o'clock to 10 o'clock subscapularis attaches onto the lesser tuberosity, although this attachment may be obscured by the overlying biceps tendon, which takes a 'question mark' trajectory as it enters the glenohumeral joint. This pathway is itself covered by the transverse humeral ligament. The space between 10 o'clock and 11 o'clock is present due to the fact the muscular bellies of subscapularis and supraspinatus are separated by the coracoid process. This area, the rotator interval, is occupied not only by the LHB, but also by the anterior shoulder capsule inferiorly and the coraco-humeral ligament superiorly. The coraco-humeral ligament originates from the lateral coracoid, just below the coraco-acromial ligament,

coalesces with the anterior capsule and inserts as the most anterior structure on the greater tuberosity. This structure also extends posteriorly, running perpendicular to the fibres of supraspinatus and thus reinforcing the supraspinatus tendon. This is visible to the arthroscopist as a curved cable running anterior to posterior along the joint side of the supraspinatus.

The infraspinatus and teres minor muscles can be observed to join each other near their insertion and are therefore often identified together and called the posterior rotator cuff.¹

Figure 1. The Insertion of the rotator cuff muscles¹.

Pathology

Rotator cuff disorders are the commonest cause of pain and loss of function around the shoulder. Causes may be split into either traumatic or non-traumatic, and intrinsic or extrinsic.

Traumatic tears are most often secondary to either shoulder dislocations or a fall. As a consequence, any patient over 45 years old, with loss of shoulder function after a shoulder dislocation or who has had more than 4 weeks of shoulder dysfunction should undergo MRI or USS imaging to investigate for a possible acute rotator cuff tear².

Intrinsic causes relate to those affecting the integrity of the tendons themselves, including age, diabetes, inflammatory conditions and more rarely connective tissue disorders such as Marfan's syndrome.

Extrinsic causes relate to damage to the rotator cuff tendons secondary to factors external to the tendon. The effect of this is impingement of the tendons. Impingement may be caused by anything that reduces the relative space the tendons have to move under the coraco-acromial space. This may be due to repetitive friction of the tendons leading to an inflammatory reaction, osteophytes on the acromio-clavicular joint or calcification of the coraco-acromial ligament forming subacromial spurs, as well as inflammatory conditions. The morphology of the acromion has also been shown to have an effect, individuals with type III (hooked) acromions having a higher risk of impingement.

Impingement often leads to pain and subsequent avoidance of any precipitating movements, which would ordinarily allow for tendon repair. With repetitive insults or impaired healing however, partial tears can develop in the rotator cuff (supraspinatus), which may progress to full thickness tears and in time larger tears, and in some patients subsequent arthritis (rotator cuff arthropathy). These non-traumatic tears usually start in the supraspinatus before extending into infraspinatus and teres minor muscles. Population studies have demonstrated that more than a quarter of rotator cuff tears are

asymptomatic³, it is unknown how many of these become symptomatic and which shoulders will progress to rotator cuff arthropathy.

Rotator cuff arthropathy is the end stage problem for patients with chronic rotator cuff tears that get larger over time, where rotator cuff insufficiency leads to superior migration of the humeral head, altered biomechanics of the glenohumeral joint, and subsequent arthropathy.

Figure 2⁴. The spiral of Rotator Cuff Lesions.

Principles of treatment¹

Generally, symptomatic acute tears are urgent problems that are treated with early surgery, especially in the young patient. There is variation in the surgical decision making for patients with chronic rotator cuff tears especially about when to intervene with surgery. However most surgeons would advocate at least some non-operative management first. There is no agreed algorithm amongst the orthopaedic community for the management of rotator cuff tears, and whilst each patient case must be considered individually, we have suggested a potential algorithm to highlight considerations the surgeon must make when deciding on a management plan (Figure 3).

For non-traumatic chronic rotator cuff tears, there are six key questions to ask in the outpatient setting in order to guide the management:

1. Is the tear symptomatic?
2. How big is the tear?
3. What co-morbidities does the patient have?
4. Is this person demographically predicted to do well with surgical intervention?
5. Is the tear associated with glenohumeral joint degeneration (cuff tear arthropathy or concurrent diseases)?
6. What non-surgical treatments are on offer, and what is their absolute or relative efficacy?

Between a quarter and a half of all full thickness rotator cuff tears are asymptomatic, as demonstrated by population-based studies¹. This highlights the poor correlation between musculoskeletal pathology and symptoms. However, outside the research setting, rotator cuff tears are usually discovered during the investigative work-up of a patient with shoulder pain. It is these patients for whom decisions for treatment are usually being made. The simple approach to this problem is: Pain + Pathology = Treat Pathology, and many patients and other clinicians find it difficult to understand why this may not be the case. It is important to remember to 'treat the patient' not their imaging because the identified cuff tear on imaging is not always the source of the patient's pain; the definitive diagnosis of symptomatic cuff tear remains one of exclusion. For example, potentially 'asymptomatic'

cuff tears exist in the presence of just under 10% of patients with idiopathic frozen shoulder. Acromio-clavicular joint pain is also cited as confounding the assessment of the rotator cuff as well as primary glenohumeral osteoarthritis, although interestingly the cervical spine is said to rarely mimic subacromial cuff tear symptoms.

However a recurring clinical concern of patients and surgeons where ambiguity continues is in the advice to give patients with asymptomatic or mildly symptomatic cuff tear. This scenario is difficult to manage, as both common sense and the scientific literature make arguments for both surgical repair and informed neglect. The fear of leaving an asymptomatic tear is that it may either become symptomatic, bigger/irreparable and/or lead to cuff tear arthropathy. There are suggestions that if a decision is made not to repair an asymptomatic, or only mildly symptomatic cuff tear then the potential to progress to an irreparable and symptomatic cuff tear should be highlighted. Operative treatments, should a tear progress and become 'irreparable', are much more limited but include augmented patch repairs, superior capsular reconstruction, muscle transfers, arthroscopic debridement and reverse total shoulder replacement. No clear information exists as to the rate of progression to irreparability over time and patients should be made aware of this. Consequently, the management of these situations does remain unclear, with the decision to treat being based on an individual risk-benefit assessment. One compromise position, albeit demanding on resources and so more acceptable in some countries more than others, may be to recommend surveillance in patients with known rotator cuff tears treated non-operatively with a view to intervening in the progressive or newly-symptomatic tear.¹

Non-operative Management

There are a number of ways rotator cuff tears can be managed non-operatively, however the evidence for each method is often confounded by the use of multiple non-operative techniques simultaneously. Non-operative methods include non-steroidal anti-inflammatories, physiotherapy, corticosteroid injections, and nerve blocks/ ablations. Whilst these are often first line treatments for rotator cuff tears, it is important to inform patients of the risks involved with non-operative management, including progression of the tear, possibly leading to impaired results of any subsequent operative management. The following studies help provide advice to patients opting for non-operative treatment.

Yamamoto et al suggest that in symptomatic rotator cuff tears, risk factors for tear progression included a medium sized tear (1-3cm (Cofield Classification)), a full thickness tear, and smoking⁵.

Maman et al also showed the progression of rotator cuff tears was associated with full thickness tears, as well as demonstrating an association between progression and age of sixty years and fatty infiltration of the rotator cuff muscles⁶. They did not identify any significant association with progression and acromioclavicular joint arthritis or the presence of an acromial spur.

Keener et al studied patients with an asymptomatic rotator cuff tear in one shoulder and pain due to rotator cuff disease in the contralateral shoulder⁷. They demonstrated that full-

thickness tears were more likely to progress than controls and partial thickness tears. They also showed that tear enlargement was greater in dominant shoulders, highlighting a possible link between activity level and tear progression. For the asymptomatic shoulders, they demonstrated that tear progression was linked with a greater risk of developing pain in the shoulder and a clinical decline in function.

Genetic factors have also been shown to have a role in both the development and progression of rotator cuff tears³ so a patient with a strong family history of rotator cuff tears often already have a view on what worked well or not for their relatives.

Whilst it is therefore unclear which asymptomatic patients may be subject to rotator cuff tear progression, these studies have shown clear risk factors that should be considered when opting for non-operative management of rotator cuff tears.

Physiotherapy

Physiotherapy is often the first line treatment for rotator cuff tears, as well as an integral part of post-operative rehabilitation. The aims of this are to help regain function around the glenohumeral and scapulothoracic joints by strengthening muscles, and improving posture and the biomechanical axis around these joints. The evidence for this is limited, with a Cochrane Review in 2016 concluding the majority of studies investigating the effect of manual therapy on rotator cuff tears being of low quality evidence, and the one trial of high quality evidence comparing manual therapy to placebo found no clinically important differences⁸. Despite this physiotherapy remains the commonly prescribed first line therapy for most patients with rotator cuff tears, combined with anti-inflammatory medication.

Abdul-Wahab et al's review of initial management of complete rotator cuff tears identified studies demonstrating the successful conservative management with physiotherapy with results ranging between 75% -91% for full thickness non-traumatic tears⁹. However, this review also highlighted the heterogeneity between studies in terms of patient selection, poorly defined interventions and quality of studies.

Non-steroidal anti-inflammatory drugs (NSAIDs)

NSAIDs work as cyclooxygenase (COX) inhibitors, reducing the synthesis of prostaglandins and thromboxanes. Their numerous effects include pain relief and an ability to help reduce inflammation.

Boudreault et al's meta-analysis found that the evidence for NSAID use in rotator cuff disease was of low-moderate quality¹⁰. This meta-analysis found that in the short term the use of oral NSAIDs reduced pain compared to placebo, but there was no functional improvements identified. Boudreault highlighted that this may be due to the short follow up (< 1 month) and further studies were recommended to investigate the effect of NSAIDs on shoulder function.

While it seems NSAIDs are useful in the short term for pain relief in rotator cuff disease, the evidence is limited by low quality studies and the lack of long term follow up. Patient factors should be taken into account when recommending NSAIDs, as they can exacerbate asthma and increase the risk of gastritis as well as interact with other drugs, and so are best managed by the patients' primary care physician.

Corticosteroids injections

Corticosteroid injections are a useful intervention for both diagnostic and therapeutic purposes in a number of shoulder pathologies causing pain. They are often the second line in conservative management following physiotherapy. Corticosteroid injections are used to help reduce inflammation and subsequent discomfort, allowing patients to re-engage with their physiotherapy programme where this previously was limited by pain. The duration of their effect is variable and some patients are given more than one injection. It is useful to ask the patient to keep a pain diary post-injection to help establish the therapeutic response and guide future management. No response may indicate pathology elsewhere causing the pain, or an incorrect location for the initial injection. In the latter case, radiologically guided injections have become very popular but more expensive with limited evidence of any improved benefit.

A Cochrane Review in 2003 investigating the effect of corticosteroid injections on shoulder pain reviewed twenty-six trials¹¹. For those relating to rotator cuff disease they concluded that there was a small benefit at four weeks for subacromial corticosteroid injections compared to placebo in two trials, but not compared to NSAID use demonstrated in the pooled results of three other trials.

Penning et al showed that at six weeks corticosteroid injections had a significant improvement ($p=0.006$) in VAS score compared to placebo injections for patients suffering from subacromial impingement, however in the long term (followed up at 26 weeks), the placebo injection had a 21% reduction in pain compared to the corticosteroid injections' 20% reduction¹².

Boudreault's meta-analysis analysed the use of NSAIDs vs subacromial corticosteroid injections¹⁰. Whilst corticosteroid injections were shown to have a significant favourable effect in terms of range of motion in abduction, there was no difference in self-reported function compared to the use of NSAIDs. Due to study heterogeneity other outcomes could not be pooled for further meta-analysis.

Platelet Rich Plasma Injections

Platelets have a role in healing by helping recruit cells and secreting growth factors involved in the healing process. Platelet rich plasma injections contain around three times the number of platelets as normal plasma and have therefore been the subject to a number of

studies investigating their role in soft tissue injuries, both as a principal treatment and supplementation to surgical repair. A Cochrane Review in 2014 concluded there was insufficient evidence to support the use of plasma rich therapies for treating musculoskeletal soft tissue injuries¹³. Whilst some of the studies included in this meta-analysis did focus on plasma rich therapy use in rotator cuff disease, this was as augmentation in surgical repair, and showed a clinically non-significant difference in favour of plasma rich therapy for the pooled Constant scores, little difference for the pooled results of pain and comparable results of retear after 2 years.

Nerve blocks/ablations

For patients with established end stage rotator cuff disease and arthropathy who are either not fit for surgery due to comorbidities, or have failed other conservative management options but continue to decline operative management, then suprascapular nerve interventions are a possible option for pain relief. The suprascapular nerve is the main nerve supplying sensation to the shoulder capsule, and thus by targeting this nerve patients may experience an improvement in their pain score. Interventions may be landmark anatomical injections or radiologically guided. Successful pain relief after a suprascapular nerve blocks often leads to attempts at more permanent relief through radiofrequency ablation of the nerve.

Kane et al showed that in 12 patients with rotator cuff arthropathy who underwent pulsed radiofrequency ablation, 10 demonstrated a statistically significant improvement in their VAS score ($p = 0.024$), Oxford score ($p = 0.001$) and Constant Score ($p = 0.05$) at 6 months¹⁴. Between 3 and 6 months there was a reduction in the VAS score which suggested wearing off of the ablation effects.

There is limited published data for the use of suprascapular nerve blocks or ablations, however many clinicians will usually trial a nerve block prior to any ablation. There have been no published studies investigating the effect of multiple suprascapular nerve blocks/ablations.

Conclusion

Rotator cuff disease is highly prevalent and represents a spectrum of conditions which can be extremely debilitating to the individual. Whilst there are numerous non-operative approaches for management of these conditions, longitudinal studies are lacking and evidence remains limited in terms of quality, duration of follow up, and heterogeneity of outcomes measure. This invariably leads to variations in practice and the advice to patients on the merits of non-surgical versus surgical treatments. More national trials are now being funded comparing different non-operative treatments as well as surgical treatments and these will help further inform decision making in the near future.

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