INTRODUCTION

The rotator cuff consists of four muscles; the subscapularis, supraspinatus, infraspinatus, and teres minor. The long head of the biceps tendon is another important component of the complex. The subscapularis is a head depressor, and in certain positions an internal rotator. The infraspinatus and teres minor are external rotators. The conjoint tendon of these muscles, attached to the tuberosities, anatomically and functionally, works as a unit, to maintain dynamic glenohumeral stability centering the humeral head onto the glenoid articulation. The long head of the biceps attaches to the supraglenoid tubercle of the glenoid and has a stabilising and depressing action on the humeral head.

The rotator cuff gives 50% of the abductor power and 80% of the external rotator power to the gleno-humeral joint.

BIOMECHANICS OF GLENO-HUMERAL MOTION

With the arm by the side, the deltoid acts to pull the humerus up, subluxing the head superiorly. On further abduction, the deltoid pulls the humeral head into the glenoid. When the arm is overhead the deltoid tends to sublux the humeral head inferiorly. The rotator cuff prevents this subluxation by pressing the humeral head into the glenoid. In the presence of a rotator cuff tear, excessive excursion of the humeral head along varying centres of rotation can occur due to loss of the compressive force of the supraspinatus.

INCIDENCE

Cadaveric studies by Fukuda et al. show that full thickness tears are present in about 20% of post-mortem dissections, whereas partial thickness tears are present in up to 32%.

AETIOLOGY

The cause of rotator cuff tears is probably multifactorial, involving some or all of the following points:

- Continued overuse of the shoulder causing attrition of the rotator cuff due to friction between the humerus and the acromion;
- Age-related changes in the integrity of the tendon associated with the constitutional condition of the patient and overuse predisposing to rupture;
- Trauma;
- Heavy overhead work, such as welding;
- Throwing and overhead sports.

A critical hypovascular zone is present adjacent to the insertion of the supraspinatus tendon just proximal to its insertion on the greater tuberosity. This avascular area seems to correspond with the area of tendon degeneration and rupture.

Lindholm and Mosely felt that the decreased vascularity in the critical zone represents an area of anastomosis between the vessels derived from bone and those derived from the muscle belly. Apart from this, with the arm in neutral and abducted position, there is constant pressure by the humeral head against the supraspinatus tendon. This compression more or less wrings the blood out of the tendon at the critical area, further compromising the site.

The supraspinatus tendon passes under the coracoacromial arch and may be subject to wear as it is compressed between the acromion and the humeral head. Neer talks about the concept of the supraspinatus outlet, through which the supraspinatus tendon passes between the coracoacromial arch superiorly and the superior edge of the glenoid inferiorly. This causes impingement with consequent attrition of the tendon, due to narrowing of the outlet. The latter may be due to:

- variations in shape/slope of the acromion
- acromial spur formation
- prominence of the acromio-clavicular joint.

DIAGNOSIS

Diagnosis is usually from the history. The housewife states that she is unable to hang the washing, but is able to work perfectly well at the kitchen worktop. The schoolteacher will
come with a history that he is unable to write on the blackboard. The main symptoms are pain and weakness of the abducted arm.

PAIN

This usually relates to the anterior aspect of the shoulder and deltoid area. The pain is not in the cervical region. Neck pain starts in the neck and is referred distally to the hand; shoulder pain is not referred proximally.

The patient indicates cuff pain by the palm sign — putting the palm of his hand over the shoulder cape area to show the painful region. Acromioclavicular joint problems e.g. joint osteoarthritis is usually brought to the examiner’s attention by the pointing sign directed to the acromioclavicular joint on the anterior aspect of the shoulder.

Cuff problems also give night pain, especially so when the patient turns over in bed on the affected shoulder. Night pain is worrying, because apart from cuff tears which is a common presentation, it can also be due to more serious pathology of the shoulder joint e.g. neoplastic problems and infection.

PHYSICAL SIGNS

LOOK

Watch the patient undress. This can provide a multitude of pointers that can lead the examiner down the right track. The patient will usually take off the shirt sleeve from the normal side first, protecting the injured arm.

Watch out for the shrug of a complete cuff tear. A patient with a complete tear will be unable to initiate abduction of the arm against gravity in any position. The patient will usually resort to trick movements to lift up the arm; by leaning sideways towards the injured arm, the patient will produce passive abduction by gravity until deltoid takes over to continue abduction.

‘Fluid Sign’ — swelling of the shoulder joint from the presence of synovial fluid in the subacromial bursa secondary to joint fluid in the glenohumeral joint. However, the amount of fluid has to be large for this sign to be present.

Prominence of the acromioclavicular joint due to osteoarthritis.

Look out for muscle wasting around the shoulder girdle. Wasting of the two main motors of the rotator cuff i.e. supraspinatus and infraspinatus is best seen in the plane of the scapula by looking at the seated patient from the top, and comparing both sides.

FEEL

Crepitus which is palpable in complete cuff tears.

Localise tenderness along the anterior edge of the acromion, the greater tuberosity of the humerus and the bicipital groove.


Look for the palpable gap in the continuity of the cuff. Wallace reports clinical sensitivity of 91% and specificity of 75%.

MOVE

The Painful arc of elevation is a misnomer. The pain is usually felt between 70° and 120°, as the arm is slowly lowered actively from the overhead position to the side. Loss of the arc of movement from 0° to 60° is usually due to a complete cuff tear; and a painful arc from 120° to 180° can be due to acromioclavicular joint problems e.g. osteoarthritis.

Positive impingement sign — in this sign, pain is felt at the anterior edge of the acromion with passive, forced, forward elevation of the arm. The examiner should stand behind the patient to stabilise the scapula with one hand. Impingement may occur between 70° and 120°. A less reliable test, is pain felt over the coracoacromial ligament with forward flexion of the humerus to 90°.

An extremely helpful diagnostic tool is the painful arc injection test. The aim of this test is to abolish pain in the subacromial space and exclude causes of referred pain from other areas such as the neck and chest. With the undressed patient sitting comfortably in a chair, 10mls of 0.25% bupivacaine is injected in the soft spot at the lateral end of the scapula just beneath the posterior lip of the acromion. Infiltration from this site is safer than from the lateral site and definitely safer then from the anterior site. After an interval of 5 to 10 minutes, the painful arc test is repeated. If pain is completely abolished, then the problem is in the subacromial space, and not referred on from surrounding joints. If pain is completely abolished and the arm is still weak, this is indicative of a rotator cuff tear problem. If pain is abolished, but there is no weakness, a tear is excluded, and the problem could be subacromial bursitis or supraspinatus tendonitis. The test is both diagnostic and therapeutic.

TESTING INDIVIDUAL COMPONENTS OF THE CUFF

• Supraspinatus test

With the arm abducted to 80° in the plane of the scapula and with the thumb pointing downwards, strength is tested with one or two fingers resistance by the examiner. Weakness
suggests a tear of this tendon. Passive motion that exceeds active motion in the abduction plane can be due either to pain or loss of the abduction power. A further corollary of this test is a positive 'drop arm' sign, which is inability to maintain the passively positioned arm in 90° abduction; this signifies a large tear. Inability to initiate abduction of the arm against gravity in any position signifies massive tears.

- **Infraspinatus test**

  Weakness of active external rotation of the shoulder joint with the elbow flexed to 90° and the forearm acting as a pointer to the extent of rotation, indicates a complete thickness tear of the tendon. Compare with the other side.

- **Subscapularis test**

  This test is done by asking the patient to internally rotate the arm behind his back, with the hand over the natal cleft, and continuing the internal rotation movement against resistance. A positive 'lift off' sign signifies subscapularis weakness/tear.

**RADIOLOGY**

Plain X-rays

**AP shoulder with 10° caudal tilt of the source.**

This will show an anterior acromial spur which is an osteophyte located along the antero-inferior edge of the acromion and is caused by the traction from the coracoacromial ligament.

**AP shoulder**

This will show cystic changes and sclerosis with irregularity of the tip of the greater tuberosity where supraspinatus inserts. There will also be superior subluxation of the humeral head with narrowing of the acromio-humeral interval, and gleno-humeral osteoarthritic changes in cuff arthropathy.

The most reliable radiographic procedure to demonstrate tears and associated problems is MRI. It can delineate the size of complete tears, hypertrophic changes on the anterior edge of the acromion and acromioclavicular joint, detection of bursitis and tendinitis and glenoid labral tears; but it is unable to differentiate between partial and full thickness tears. As yet, MRI is unavailable locally, but an equally useful procedure that can be done is arthrography with or without double contrast. Visualisation of intra-articularly injected contrast material (in the glenohumeral joint), extending into the subdeltoid region is the single arthrographic criterion of a complete rotator cuff tear.

**Neer’s indications for arthrography are:**

- Impingement syndrome persistent beyond 12 weeks in over 40 years olds.
- Injury with ‘sudden marked shoulder weakness’.
- Ruptured long head of biceps with shoulder symptoms.
- Unstable or symptomatic shoulder after dislocation in over 40 years olds.

**Ultrasonography** is a non-invasive and inexpensive test that permits examination of both surfaces of the cuff. Comparison can be made with the contralateral shoulder and may be of use in the evaluation of the post-op shoulder. This test is user-dependent and does require an interested radiologist.

The role of joint arthroscopy/bursoscopy is controversial and depends on setup availability and expertise.

**MANAGEMENT**

Treatment of cuff tears depends on several factors including age of the patient, athletic prowess, and associated impingement.

**CONSERVATIVE MANAGEMENT**

A large percentage do well with conservative management. This will involve decreasing the pain and rehabilitating the rotator cuff, and avoiding harmful and provocative motions. The initial management is treatment of pain and rest. Infiltrations into the subacromial bursa with local anaesthetics are quite useful to ablate the pain. Local infiltration of steroids into the cuff area should be avoided (except in calcific tendonitis problems), as this can lead to tendon degeneration of the cuff. NSAIDs are useful to decrease the inflammation and oedema of cuff tears.

The shoulder is not used for activities of daily living above 60° of abduction and flexion. After the pain is decreased, strengthening exercises of the cuff components are initiated, including supraspinatus and infraspinatus, together with stretching exercises. Physiotherapeutic rehabilitation is the keystone of conservative management and this should be carried out for periods of up to 3 months. This is the first stage in the management of rotator cuff tears in non-athletes and athletes with small tears producing minimal signs.

If there is no improvement during the rehabilitation phase after 3 months, the second stage of management comes in; and this will include further investigations, including an arthrogram as well as plain films to exclude impingement.
Surgery is done to decompress the subacromial space and to repair full thickness rotator cuff tears. Decompression will include anterior acromioplasty with resection of the prominent inferior acromioclavicular joint spur and excision of the coracoacromial ligament.

The goals of surgical treatment of rotator cuff tears are:

- Tensionless repair with the arm at the side and snug apposition of healthy tissue.
- Restoration of the muscle/tendon unit attachment to the humerus.
- Production of a smooth surface and watertight closure.

RESULTS

Good results have been reported with arthroscopic subacromial decompression, and this is a promising alternative to open acromioplasty in selected patients without full thickness cuff tears. Repair of small cuff tears arthroscopically is possible, but in centres where the necessary expertise is lacking, and there are multiple pathologies to sort out, it is probably wiser to perform an open cuff repair together with decompression.

REFERENCES