The painful Shoulder

The shoulder pain is a diagnostic conundrum full of pitfalls. The pain of impingement for example is a common presentation for example even of instability. Clicks in the shoulder have a variety of reasons including a inflamed bursa abrading on the acromion, SLAP lesion, subtle subluxations of instability. There are various causes for painful shoulder. The most common that is seen in outpatients are those relating to the rotator cuff and its pathology.
Other causes pain depend on the age at presentation
In the young patient the cause is usually instability where as in the middle aged it is rotator cuff, pathology, subacromial bursitis , acromioclavicular wear, and in the elderly is degenerative cuff disease, glenohumeral arthritis, and cervical spondylosis
Pain in the shoulder can be referred from the neck usually as part of a radiculitis. Anterior shoulder pain is often difficult to attribute to a single cause quite often a combination of pathologies are possible. Subacromial bursitis with rotator cuff tendinitis being most common, other entities including bicipital tendinitis, internal impingement, coracoid impingement, acromio Clavicular arthritis, anterosuperior articular lesions on the humeral head and Slap lesions have to be borne in mind.
The clinical examination of the painful shoulder is also not without difficulty as all the above can cause antero superior pain with impingement like presentation. A careful history and diligent examination is essential.

Pain in Shoulder
Young upto 30
Some that are related to a traumatic event include
1. Instability- traumatic
2. Ac joint strain
3. Slap lesion –
4. Traumatic impingement
5. internal impingement, thrower's shoulder
6. rotator cuff tears
Nontraumatic causes of pain
7. Impingement/ Calcific tendinitis
8. Avascular necrosis of humeral head
9. Juvenile rheumatoid
10. Instability- / atraumatic
11. OS acromiale
12. Scapulo thoracic bursitis
13. Neurologic
    Parsonage- Turner Syndrome
    Entrapment of suprascapular nerve
    Cervical radiculitis

Older adult – while all of the above can present in the older adult some are seen specifically in this age group

1. rotator cuff degeneration and subacromial bursitis
2. rotator cuff tears
3. calcific tendinitis
4. early stages of adhesive capsulitis
5. Osteoarthritis of GH and AC joints
6. rheumatoid arthritis
7. Secondary tumor

And in both groups rarely primary bone tumor, chronic regional pain syndrome.

Rotator Cuff disease

The rotator cuff is one of the most important tendon complex that helps in the movement and stability of the shoulder joint. It is prone to degeneration and tendinosis and thus can undergo attrition rupture.The muscle action is complex and the articular surface of tendon is closely applied to the bone and cartilage. On its bursal surface it is separated from acromion and the coroco acromial ligament by the subacromial bursa. The Acromioclavicular joint is also closely applied to the supraspinatus and any mild osteophytes can impinge on the tendon. The bursa itself can be painful and has a rich nerve supply.

Rotator cuff tendinitis

The pathology of tendinosis is one of degeneration within the tendon with age. There are some studies implicating genetic and mechanical factors. The role of the coroco-acromial arch especially the undersurface of the acromion in the etiology of the disease is debated and it is well known to perpetuate the pain.

Zuckerman, j. d. / Kummer, f. j. / Cuomo, f. / Simon, j. / and Rosenblum, s.: The influence of the coraco-acromial arch anatomy on rotator cuff tears. j. shoulder and elbow surg. 1992 / 1:4-14.

Intrinsic factors
Muscle fatigue and overload in tension especially in overhead activities
Tendinosis
Overuse of the shoulder

Extrinsic factors
Malunion of greater tuberosity fractures
 Instability of shoulder
Osteophytes from acromio Clavicular joint

Acromial spur: classified into three types on outlet radiographs as Type I – flat, Type II – curved and type III – hooked. The hooked acromion being most commonly associated with tears.

 L U Bigliani Variations in acromial morphology. Orthop. Trans. 1987 / 11:234.

The painful rotator cuff due to inflammation is the most common presentation in clinic.

Charles Neer described the three stage of impingement
Stage 1 reversible oedema and haemorrhage,
Stage 2 Fibosis and tendinitis
Stage 3 Tears and bone spurs on acromion

He also divided impingement into outlet impingement (due to coraco acromial arch) and non outlet impingement (inflamed bursa and/ or tendon) and advocated excising the antero inferior acromion.

Neer CS II Anterior Acromioplasty for Chronic Impingement Syndrome. A Preliminary report JBJS Am 54: 41-50 1972

Clinical presentation

The pain is felt usually in the upper lateral aspect of the arm and quite often radiates to the elbow. The pain is dull ache with most activities and can be sharp in certain positions of the arm i.e in abduction or internal rotation. The patient typically complains of inability to reach back pocket, fasten bra strap, inability to comb hair and in the severe cases is not able to do any overhead activities. It becomes difficult lying on the side and in the chronic cases can lead to severe stiffness. The stiffness usually starts in the posterior capsule and is apparent as reduction in internal rotation.
There is a painful arc which is pain at mid levels of elevation and disappears in full elevation. There is association with cervical radiculitis with tingling down the arm.
Neer impingement test : is when an injection of local anesthetic in the sub acromial space reduces the pain and eliminates the weakness

Hawkins sign: pain felt on internal rotation of the flexed shoulder
Neer sign: pain on elevaton in the scapular plane at 70 – 90 degrees.
There is often tenderness at the codmans point best examined with the hand behind the back, i.e. shoulder extended and internally rotated.

Radiography
This helps demonstrate reciprocal sclerosis and subchondral cysts of the greater tuberosity and acromion. It also shows calcific tendinitis and ACJ arthritis. The axillary lateral is useful in looking for OS acromiale. Ultrasound or MRI is helpful in delineating the status of the rotator cuff.

Treatment

Many studies confirm that 60% of patients resolve with nonoperative management. These include avoidance of activity, physiotherapy, non steroidal inflammatory drugs and subacromial injection of steroids. All patients should have a non operative trial of a

minimum of six month but preferably longer. The morbidity with the arthroscopic acromiolasty is much reduced that it is being recommended more often much earlier.

Operative treatment involves either open or arthroscopic subacromial decompression. There is at this moment no advantage for one over the other. The Acromioclavicular joint is excised usually only if symptomatic or grossly arthritic on the xray.

Ellman, h.: arthroscopic subacromial decompression: analysis of one- to three-year results. arthroscopy 1987 / 3:173-181.

Rotator Cuff tears

The rotator cuff maintains a balance force couple that helps in movement of the shoulder in space as well as kepe the fulcrum centered within the joint. Even with a suprasinatus tear this force couple is maintained to allow full range of motion.It is the aim of repair surgery to balance this force couples in all planes when it is disrupted and also to relieve pain.

Tears of the rotator cuff can be symptomatic or asymptomatic. The most common location being in the tendon of suprasinatus. The tears can be either commonly posterosuperior (Supraspinatus, infraspinatus and rarely teres minor) or less commonly anterosuperior Supraspinatus and subscapularis).

Tears are classified by the size of the tear as Small < 1 cm, medium 2 to 3 cm, Large 3 – 5 cm and Massive above 5 cm but this alone is not useful. It is important to determine whether the tear is
- a. Acute or chronic
- b. Traumatic or atraumatic
- c. Retracted (mild, modrate uncovering the head, severe retracted to and beyond the glenoid))
- d. Quality and delamination
- e. Wasting and if wasted is there fatty infiltration (MRI)
- f. Associated stiffness (examination +/- under anesthesia

In order to answer all the above the initial history examination and investigations help immensely. The investigations of choice would start with the radiographs – an anteroposterior and a axillary lateral view. The gold standard investigation is MRI and is specific for cuff tears and to assess
1. fatty infiltration
2. other soft tissues including biceps, cartilage, SLAP lesions, state of ACJ, and
3. In the young it can help assess labrum but a MR arthrogram is more useful in this.

The office ultrasound is cheaper and much faster. It is operator dependant and is best done in the clinic setting either by an accompanying radiologist or the surgeon, the sensivity and specificity for medium to large tears is very good., Small tears are less so. Partial thickness tears are difficult to diagnose.

The examibnation of the patient under anesthesia adds to the clinical picture as well as the diagnostic arthroscopy and assessment of tear. Rarely a nerve conduction study is

helpful when the wasting is disproportionate to the size of the tear to look for suprascapular nerve damge.

The tears occur most often due to degeneration of the tendon and with chronic tension and stresses on the tendon at its insertion. Eccentric load is an important factor in the tear propogation,These histologic changes of degeneration include decreased cellularity and some of this is genetically determined

Kannus P, Józsa L. Histopathological changes preceding spontaneous rupture of a tendon: a controlled study of 891 patients. *J Bone Joint Surg [Am]* 1991;73-A:1507–25

Traumatic tears occur in patients younger than 50 or in the elderly with minimal trauma in a degenerative cuff.
Vascular - blood supply changes have been demonstrated with degenerate cuffs and in cuff tears and the avascular codmans zone has been demonstrated 1 cm from insertion but role in pathogenesis not clear yet.
Reduced cellularity and metabolism has been shown at the edge of tears especially with large tears which may influence the capacity to heal
The role of compression from impingement in the pathogenesis is questionable.

Matthews TJW, Smith SR, Peach C, et al. In-vivo measurement of tissue metabolism in rotator cuff tendons: implications for surgical management. *J Bone Joint Surg [Br]* 2007;89-B:633–8.

Clinical Presentation

The cuff tear are not symptomatic in all patients. In asymptomatic patients above 60 there is a 30% incidence and this increases with age. We still do not know why the presentation varies so widely in different patients.

Yamaguchi K, Tetro AM, Blam O, et al. Natural history of asymptomatic rotator cuff tear**s:** a longitudinal analysis of asymptomatic tears detected sonographically. *J Shoulder Elbow Surg* 2001;10:199–203

 In the symptomatic patients the symptoms include all that was mentioned under impingement. In addition there is weakness which can be subtle in the small and medium tears. Weakness is apparent in large and massive tears. In the acute on chronic tears patients are not able to lift their arms and there may be ecchymosis of the anterior arm. The pain levels are not severe in the later stages but functional limitations can be. Weakness and stiffness are the causes for this, Stiffness usually is not part of the clinical presentation but can ensue in the direction the shoulder is not moved. Again internal rotation is more markedly diminished than others. But yet in other chronic tears the arm elevation is good because of compensatory deltoid activity.
The weakness when marked can lead to a drop sign. This is inability to sustain a contraction in the position the muscle should act and the arm drops limply. This is usually demonstrated as internal rotation lag sign or external rotation lag sign. External rotation

lag sign is elicited by passively positioning the arm in maximal external rotation. When there is marked weakness, the patient is unable to hold the arm in this position and the hand falls. The hornblower's sign, an inability to externally rotate the elevated arm, also demonstrates severe infraspinatus weakness.The prognosis for repair is guarded in these patients. External rotation weakness is more consistently demonstrable than abduction (deltoid compensation).

Subscapularis tear is rare (around 5 %) and presents with internal rotation weakness, excessive passive external rotation, and a positive lift-off test. This test is difficult to elicit due to pain of internal rotation and a belly press test may be more appropriate

It is important to determine the chronicity of a tear for management decisions. If there is wasting of the supraspinous and infraspinous fossa in a patient presenting after an acute injury it more than likely that this is chronic.

1. Cuff Tear
   a. No wasting - acute on chronic, acute
   b. Wasting – Chronic, acute on chronic
      i. Fatty infiltration
      ii. Normal muscle

Chronic tears are detectable from a long standing history, with accompanying wasting, stiffness, and xray changes. Xray changes include some superior migration of humeral head, reciprocal changes in the greater tuberosity and acromion and a reduced acromion hemeral distance below 7 mm, normal being about 10 mm. In advanced massive cuff tears the humeral head starts subluxing upwards and develops mild arthritis changes given the abnormal joint mechanics. It is important to rule out arthritis as management will differ and the arthropathy can progress but is not predictable.

Management

Codman I 1934 summarized his work on the rotator cuff and proposed surgery for the torn cuff. He proposed that there is an avascular area in the supraspinatus at about 1 cm from its insertion where most of the degenerative tears occur.(Codman's point)

Codman Tendon and other lesions in or about the subacromial bursa. Boston, Thomas Todd, 1934.

The investigations of choice would start with the radiographs, and ultrasound.MRI or MRI arthrograms can be considered if surgery is contemplated.

Non operative management

Non operative measures are variously reported as being effective between 33% to 90% of patients. Good prognostic indicators include small tears, duration less than a year and a well motivated patient. In most literature 30 to 40% of patients deteriorate or do not get better. The decision not to operate has to be balanced against acuteness of the tear, the potential for tear propagation and adhesions over a long non operative treatment protocol.
.

The options for symptom relief include activity modification, injection therapy but steroid should be repeated only twice at least 3 months apart and non steroidal anti inflammatory drugs. This pain relief is helpful with adherence to physical therapy regimes. For the massive tears the deltoid strengthening exercises are helpful in restoring some function if done in stages first eliminating gravity. Rotator cuff strengthening is started with the arm by side at waist level and scapular stabilizers help as well.

The need and the timing for operative treatment is still not settled as most studies or single centre non randomised cohort studies and mostly retrospective. But most surgeons allow for a trial of nonoperative treatment of at least 6 months depending of symptom severity and age.

Oh LS, Wolf BR, Hall MP, Levy BA, Marx RG. Indications for rotator cuff repair: a systematic review. *Clin Orthop* 2007;455:52–63

Wirth MA, Basamania C, Rockwood CA Jr. Nonoperative management of full-thickness tears of the rotator cuff. Orthop Clin North Am 1997:28:59–68.

The young (50 and below) patient would benefit from an early intervention in the symptomatic shoulder. In the elderly 65and above the quality of the tendon tends to be poor and are best treated with nonoperative management in the first instance and surgery is reserved for the refractory patient. The large and massive tears are prone to retear (40 to 50%)

Both open and arthroscopic treatment have good results. The advantages of arthroscopic treatment being that it is minimally invasive and procedures like suprascapular nerve release and repair of labral tears can be done simultaneously.

Surgical repair is considerd
1. After atrial of at least 3 month of nonoperative treatment (often upto 6 months)
2. In the acute tear in the active adult
   Bassett RW, Cofield RH. Acute tears of the rotator cuff. The timing of surgical repairs. Clin Orthop 1983;175:18–24

3. In severe disabling pain not responding to nonoperative measures within 6 – 8 weeks

Open repairs

Open repairs are easier to do and have equally good results. The open surgery invoves a lateral deltoid splitting approach and the visualisations is through the narrow window and the head is rotated to bring cuff tissue to view. This limits the surgeon in the dissection though not impossible. When done through the antero superior approach extensions along the deltoid insertion either anteriorly or posteriorly if need be can help visualiuse cuff. The approach anteriorly is through the deltopectoral approach for the subscapularis tear. Mini open antero superior approach has been used successfully in the small and medium sized tears. Open repairs are the gold standard and arthroscopic repairs now provide as good and in the experienced hands better results.

Arthroscopic repair

The basic aim at repair is to recreate the footprint of the cuff insertion at the greater and lesser tuberosity. The better biomechanical fixation yields a better biologic result. The important considerations would include the skill of the surgeon, The quality of the tissue and the patient, The material biomechanics include suture interfaces with the anchor and the tsisues and finally the rehabilitation protocols.

The tear size location and quality of tendon can be all macroscopically assessed at arthroscopy and serve as predictor to the final result. The tears are assessed for mobilization and reapir principles and classied as C shaped when the centra tendon mass at insertion gives way, U shaped tear a extension of the C shaped with retraction,L shaped as a linear limb retracts from its attachment, and reverse L shaped when this retraction happened posterior to anterior. And a combination and compleax teras. Repairs are either side to side when the anterior and posterior limbs are simply brought together or end to bone when the tendon is brought to the humeral head usually to its insertion at the tuberosity. The fist techniwue of side to side repair is also called margin convergence (in U shaped tears) Rarely the repair is medialised especially in the massive tears as they cannot reach the tuberosity. Bone anchors are used to secure the tendon to bone. The ancors can be used as a single row in the simple tears but as a double row (one medial and other lateral) to secure a more biomechanically strong fixation.

In massive tears the measure of irreparability is constantly changing as advanced techniques of mobilization help achieve repair in these massive tears. The potential damage to suprascapular nerev at the spino glenoid notch has to be borne in mind

Subscapularis tears are much less common than posterior cuff tears and are technically more demanding due to constraints of the subcoracoid space. The axilary nerve at its inferior border neeed to be protected.

Results of cuff repair is better with small to moderate tears in good tendon quality. The overall retear rate is 15 - 20% But with massive tears there is a recurrence rate of 30 to 40 %. The overall satisfaction rate in various series is between 80 to 95 % and though retear reduces the degree of improvement it still gives a significant improvement for pain relief and less so for functional rehabilitation and satisfaction of the patient. Cuff repair (retear or not) gives ssuperior results to acromioplasty and debridement alone.

Poor prognostic factors
Massive tears and increasing age and reduced tendon quality
Fatty infiltration of muscle
Patient comorbidity i.e. diabetes
Smoking

Burkhart SS, Danaceau SM, Pearce CE Jr. Arthroscopic rotator cuff repair: analysis of results by tear size and by repair technique-margin convergence versus direct tendon-to-bone repair. Arthroscopy 2001;17(9):905–912.

O. Levy, B. Venkateswaran, T. Even, M. Ravenscroft, and S. Copeland
Mid-term clinical and sonographic outcome of arthroscopic repair of the rotator cuff
J Bone Joint Surg Br, Oct 2008; 90-B: 1341 - 1347.

Specific issues

1) The role of concomitant acromioplasty is being questioned. Gartsman published that there were no differences in the type 2 acromion. But most surgeons would include acromioplasty as part of the repair but caution has to be exercised in the cuff deficient shoulder.

Arthroscopic rotator cuff repair with and without arthroscopic subacromial decompression: a prospective, randomized study of one-year outcomes
Gary M Gartsman, Daniel P O'Connor
Journal of Shoulder and Elbow Surgery
July 2004 (Vol. 13, Issue 4, Pages 424-426)

2) Partial thickness rotator cuff tears can lead to persistent pain. If rehabilitation fails treatment can include debridement in the young patient to debridement and acromioplasty and in some severe partial tears excision and repair of the tear

Weber SC. Arthroscopic debridement and acromioplasty versus mini-open repair in the management of significant partial-thickness tears of the rotator cuff. Orthop Clin North Am 1997;28:79–82.

3) Internal Impingement: a process of damage to the rotator cuff insertion at the greater tuberosity in extremes of abduction and external rotation with fraying of the undersurface. Reciprocal changes on the postero superior glenoid labrum may be visible at times. Treatment is usually rehabilitation. Since this is an arthroscopic diagnosis treatment also involves arthroscopic debridement but with demonstable instability a capsular placation is recommended at times.

Walch G, Boileau P, Noel E, Donell ST. Impingement of the deep surface of the supraspinatus tendon on the posterosuperior glenoid rim: an arthroscopic study. J Shoulder Elbow Surg 1992;1:238–245

4) Rehabilitation after cuff tear varies depending on the anatomy and biomechanics of the repair. An abduction pillow is usefull in massive tears and a simple shoulder immobilizer in other sound repairs for at least 6 weeks. Passive motion is begun early by most surgeons.
5) The use of extracellular matrix for biologic repair of the cuff is practiced by some surgeons.These are naturally occurring and are processed to remove cells to reduce antigenicity – e.g graft jacket (Dermis). These as yet do not provide a structural support to the repair.
6) Massive tears- the fatty infiltration can be staged as per Goutallier. there are various treatments advocated including debridement and partial repair, mobilization and

repair, synthetic materials, tendon transfers, biologic augmentation and arthroplasty. In most instances a tear is considered irreparable mostly after a repair is attempted. In the healthy active individuals an early reapir is easier to do as even 6 weeks can lead to severe retraction, scarring and any longer to fatty infiltration

Tendon transfers include upper part of subscapularis, and more frequently Lattisimus dorsi.

Goutallier D, Postel JM, Bernageau J, Lavau L, Voisin MC. Fatty muscle degeneration in cuff rupture. Clin Orthop 1994;304:78–83

Gerber C, Fuchs B, Hodler J. The results of repair of massive tears of the rotator cuff. J Bone Joint Surg Am 2000;82(4):505–515