Chapter 7

Shoulder Arthroscopy

Jeremy Rushbrook, Panayiotis Souroullas and
Neil Pennington

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/55005

1. Introduction

Shoulder arthroscopy has become increasingly popular as the modality of choice for interventional procedures in surgery. Results for treatment of instability and rotator cuff disease are comparable with open procedures, yet with much reduced morbidity. Some pathology (such as SLAP lesions), visualised and treated with much difficulty at an open procedure are more easily and successfully managed at arthroscopy. The greatest limitation to success is the difficulty in understanding the complex anatomy from the view of the arthroscope, and the principles of management for the common conditions. This chapter presents an overview of indications, technique, anatomy and treatment options to aid understanding.

2. History of shoulder arthroscopy

Shoulder arthroscopy was first performed in 1931 by the American Dr Michael Burman [1]. He developed techniques on cadavers of which many principles are still practiced today. These include joint distension using fluid or air, the use of traction for distraction and the importance of positioning. The Second World War slowed progression until Dr Masaki Watanabe began to modify arthroscopic equipment in the 1950’s [2]. Development during subsequent decades produced smaller diameter arthroscopes, higher quality lenses, fibre-optic light sources and the charge coupled device (CCD) camera [3].

Clinical shoulder arthroscopy developed at a slower rate to that used in the knee, with the first application described by Andren and Lundbery in 1965 for the treatment of frozen shoulder [4]. Watanabe described the posterior portal in 1978 [5] and began to describe the anatomy of the shoulder as viewed through the arthroscope [6]. Conti shortly after described the anterior portal [7]. Shoulder arthroscopy soon became popular, especially in the treatment of dynamic glenohumeral joint and subacromial disorders. As techniques develop, arthroscopy has been used to perform acromiaclavicular joint stabilisations and excision, suprascapular nerve releases, bone block transfers and even latissimus dorsi transfers.

3. Indications

3.1. Diagnostic

Shoulder arthroscopy was initially introduced as a diagnostic procedure, and this remains an important part of its use. Both intra- and extra-articular shoulder structures are accessible with the arthroscope, which causes minimal tissue damage. Its use has led to the description of several pathological entities, such as the Superior Labrum Anterior Posterior (SLAP) lesion. The glenohumeral joint (GHJ), subacromial space, acromioclavicular joint (ACJ) and scapulothoracic articulation are all accessible. In addition, neurovascular structures such as the axillary nerve, suprascapular nerve, brachial plexus and axillary vessels are all within reach. Following examination under anaesthetic, a systematic diagnostic arthroscopy should be performed in all cases, before therapeutic intervention is initiated. This ensures all relevant pathology and abnormal anatomy is identified.

3.2. Therapeutic

3.2.1. Glenohumeral joint

Instability: Modes include a Bankart repair for anterior/inferior tears, capsular shrinkage / plication for atraumatic instability, as part of a Bankart repair or for internal impingement (Thrower's shoulder). In addition is the Latarjet procedure, now able to be performed arthroscopically, is found to be effective in 5 different scenarios: a. Instability with glenoid bone loss, b. Instability with humeral bone loss, c. combinations of glenoid and humeral bone loss, d. in cases of complex soft tissue injury (e.g. HAGL lesions) and finally e. as a revision procedure for failed Bankarts repairs [8].

- Cuff pathology: In cases of calcific tendinitis and rotator cuff tears
- Capsular pathology: Adhesive capsulitis intractable to NSAID's and physiotherapy.
- Biceps tendinopathies: SLAP lesions (proximal biceps-labrum complex lesions), tendon subluxation/dislocation, or biceps tendinopathy.
- Synovial disorders: Synovitis, Synovial chondromatosis and PVNS (Pigmented Villonodular Synovitis)
- Septic arthritis: Washout.
- Ganglia/Cysts: Decompression.
- Cartilage lesions (OA): Grafting.

3.2.2. Subacromial space

- Impingement
- Cuff pathology: Calcific tendinitis, rotator cuff tears.

3.2.3. Acromioclavicular joint

1. Instability
2. Dislocation
3. Degeneration

3.2.4. Suprascapular nerve

1. Entrapment: Nerve release

Scapulothoracic articulation

2. Snapping scapula: Bursitis, osteochondroma.

Muscle transfers

3. Large irreparable cuff tears: Arthroscopic Latissimus dorsi transfer.

4. Anaesthesia for shoulder arthroscopy

4.1. Examination under anaesthesia

A thorough history and clinical examination, supplemented by radiological examination leads to a correct diagnosis pre-operatively in the majority of cases. An examination under anaesthetic (EUA) will confirm such diagnoses, and can reveal valuable information that can occasionally lead to a change in the operative plan, such as unrecognised instability not detectable on clinical examination due to pain [9].

4.2. Passive range of movement

Passive range of movement is recorded in all planes, and attention must be paid to the point at which scapulothoracic movement commences. A comparison should always be made to the contralateral shoulder, particularly in the case of frozen shoulder. A goniometer can help quantify measurements.

4.3. Glenohumeral stability

Anterior and posterior translation should be performed and graded. Standing behind the patient, the scapula is stabilised with one hand whilst the other centralises the humeral head with an axial load, and then applies an anterior and posterior translation force. Grading is as follows:

- Grade 1 The humeral head can be translated to the glenoid rim
- Grade 2 The head subluxes over the glenoid rim but spontaneously reduces with release of force
- Grade 3 The head dislocated over the glenoid rim and remains dislocates after release

The test is performed in varying degrees of abduction and rotation when occult subluxation is suspected, and to allow the assessment of an engaging Hill-Sachs lesion [10].

5. Patient positioning [11]

Operating room setup and patient positioning are essential for the success of shoulder arthroscopy. Setup needs to allow sufficient space for the surgeon to move about freely, with one and possibly two assistants, the scrub nurse and all equipment to hand. A mayo table is usually positioned near the patients shoulder such that the surgeon is able to easily reach frequently needed equipment. The arthroscopy stack needs to be in a position that is easily viewed whilst operating, and the anaesthetist and anaesthetic equipment must not interfere with the surgeon. Blinds on windows should be drawn and room lights dimmed to facilitate viewing on the display. The patient is positioned either in the beach chair or lateral decubitus position, depending on surgeons preference. The patient is usually anaesthetised prior to positioning.

5.1. Lateral decubitus

The lateral decubitus is the traditional positioning for the shoulder arthroscopy, allowing excellent access and visualisation without the need of an assistant when balanced traction is applied. Following anaesthetic, the patient is positioned supine on the operating table to allow examination of both shoulders. An axillary roll can be placed on the unaffected side to protect the neurovascular bundle. The patient is then turned onto the contralateral side and held in position with pelvic supports. Pillows are placed between the legs and all bony prominences are padded. Special attention must be paid to the cervical spine to avoid excessive lateral flexion.

The arm can then either be placed into traction prior to preparing, or the entire arm can be prepped, and then placed into suspension, depending on surgeon preference and equipment availability. Traction load can be adjusted to provide distraction when required. The operating table is then tilted posteriorly by 30 degrees to position the glenoid parallel to the floor.

The lateral decubitus position allows gravity to work in favour of the surgeon, and makes the operation less physically demanding as the surgeons' elbows are kept by their side. Disadvantages include the need to lift and turn the patient, the possibility of excessive traction resulting in neurovascular injury, limited access to the anterior shoulder requiring repositioning if an open anterior approach is needed, and the tendency for suspension to place the arm in internal rotation.

http://dx.doi.org/10.5772/55005

5.2. Beach chair

The beach chair position has been adopted by many surgeons, and has been modified from the traditional position with the patient reclined at 45 degrees, to a more upright position. This allows easier orientation of the anatomy as it is in the more natural position of the patient, places the acromion parallel to the floor, and allows easier access to the posteroinferior shoulder.

The patient is anaesthetised supine and moved onto the operating table. The hips and knees are flexed as the patients back is raised to avoid the patient slipping down the table. A pillow can be placed below the knees and a footrest applied in addition. This seated position facilitates an interscalene block as either an adjunct to general anaesthetic, or as primary anaesthesia. Both shoulders are examined with the patient in this position. A variety of arm holder devices are available, with pneumatic devices becoming increasingly popular as they alleviate the need for an assistant to apply distraction to the arm.

Complications related to the beach chair position include transient hypotension and bradycardia particularly after interscalene block, known as the Bezold-Jarisch reflex, neurovascular injury particularly with pneumatic traction devices and intolerance to regional anaesthetic if used as the sole form of anaesthesia. Cardiac events and stroke are also more likely with the patient in a beach chair position.

6. Arthroscopic portals [12]

6.1. Introduction

An understanding of the normal anatomy of the glenohumeral joint is absolutely imperative in appreciating the position of several structures which are potentially at risk during an arthroscopic procedure. Equally important is spacial awareness of the subacromial space in positioning the arthroscopic portals depending on the indications as well as the desired outcome.

6.2. Positioning of portals

To the expert surgeon, portal entry is fairly simple and almost always intuitive. Positioning of the patient and choice of portal entry are essential in allowing for satisfactory view of the structures and joint, economy of movement aiming for minimum damage to soft tissues and neurovascular structures and finally in permitting the unhindered handling of instruments.

6.3. General technique

The commonest advice in approaching the joint for portal entry involves starting at the “soft spot” and aiming towards the coracoid. This is only slightly helpful as actual entry requires precision, and a deviation of even 3-5mm from the desired or intended position may render the operation technically difficult.

Marking the bony anatomical landmarks, which tend to be the most reliable in terms of a fixed location, greatly assisting in identifying the correct position for portal placement. Anteriorly, the coracoid process (CP), the acromioclavicular joint (ACJ) and the anterior border of the acromion are located and marked with a surgical site pen. Laterally, the lateral border of the acromion is palpated. More importantly, posteriorly and laterally lies the posterolateral corner of the acromion, a landmark that can be palpated even in obese patients. The scapula spine is also palpated and outlined on the patient. One may also choose to mark the biceps tendon in the bicipital groove, and the conjoint tendon. A bursal orientation line can be constructed with the posterior ACJ edge as the starting point, extending 4cm laterally and down the arm. This line marks the start of the subacromial bursa, proves the anterior nature of its position and can be particularly helpful in the placement of the lateral portal.

One must continuously remember that scope movement through the portal resembles movement through an hourglass with a pivot point (narrow point) at the portal level. The scope normally utilized is a 30-degree scope and alterations to the direction of the lens by means of rotation of the light source allow for an improved 3-dimensional perspective of the anatomy under assessment. Introduction of a probing needle is used as a confirmation tool prior to formation of a definitive portal in an attempt to optimize portal positioning and ensure adequate access to the structures under investigation.

Basic portals will be named A to E followed by F to K for the potentially more advanced ones.

6.4. Posterior Portal / Portal A: Glenohumeral and subacromial portal

Conventionally, surgeons describe entry for this portal at the “soft spot”. This is traditionally located 2cm inferiorly and 1cm medially to the posterolateral acromial edge. A needle is advanced towards the coracoid and into the inferior apex of the triangle formed superiorly by the acromion, laterally by the humeral head and medially by the glenoid. As mentioned before, the needle acts as a directional guide pointing towards the joint. Occasionally, one may witness a hissing sound, which serves as a confirmation that the needle is within intra-articular space. A 5mm skin incision is then made and the arthroscope containing a blunt trocar is inserted into the joint. The contralateral hand of the surgeon is placed at the tip of the coracoid and the trocar is directed towards the middle finger of that hand, in an attempt to aid in the correct insertion. in the more technically challenging cases, the apex of the triangle, i.e. the joint line, can also be visualized by carefully riffling the scope tip over the posterior glenoid edge, before advancing it straight into the joint. Once the scope successfully enters the joint space, there is a feeling of “give”.

The camera can then be inserted to confirm visualization of the following structures:

1. Anterior capsule, glenohumeral ligaments, rotator cuff intervals, superior 1/3 of subscapularis, intraarticular biceps tendon inferior recess of the labrum, glenoid and humeral surfaces, supraspinatus and infraspinatus muscles.

2. Internervous plane: plane between infraspinatus(suprascapular nerve) and teres minor (axillary nerve).

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3. Structures at risk: Axillary nerve, posterior circumflex humeral vessels. The posterior deltoid fibres, as well as infraspinatus fibres may be traversed by way of this portal.

Even though this approach gives sufficient access to the glenohumeral space/joint, there is an obvious technical disadvantage in attempting to use the same portal for gaining adequate access to the subacromial space. Because the arthroscopic view via this portal is directed medially, the lateral insertion of the rotator cuff cannot be adequately visualized. Furthermore, because of the superior angle of the scope, it is more difficult to produce a "bird's eye" view of the rotator cuff thus not allowing for a good appreciation of potential rotator cuff lesions.

Consequently, the first portal is slightly modified to gain access to the subacromial space. Upon completion of the glenohumeral joint examination. The scope is reintroduced with the trochar but redirected towards the anterolateral corner of the acromion. A sweeping motion is also used to tidy up any adhesions prior to pushing fluid through to re-initiate joint distention. The camera is then reinserted and a bursoscopy is performed.

Structures seen using this approach include:

1. subacromial space, ACJ, bursal aspect of the rotator cuff, extra-articular biceps, coracoid and the coracoacromial ligament.
2. The posterior deltoid fibres are once again at risk.

A second posterior portal also becomes necessary owing to the aforementioned technical difficulties.

6.5. Portal B – Posteriolateral portal : Subacromial

This portal serves as an access point to the posterior labrum and posterior rotator cuff aspects. Entry point is traditionally found at 1cm antero-inferior to the posterolateral edge of the acromion.

This portal is often used in posterior Bankart lesion repairs, instrumented repairs and suture managements, and allows visualization of the above mentioned structures when advanced.

Once again, the posterior deltoid fibres may be traversed, and there is a risk of damage to infraspinatus particularly if the portal is used to instrument articular structures. The axillary nerve is now in close proximity lying only 4-5cm inferior to the portal entry point.

6.6. Portal C – Lateral subacromial portal

This constitutes the first portal in cases where the intended procedure includes subacromial decompression, adhesive capsulitis release, or repair of massive rotator cuff tear.

The entry point is located at the midpoint if the acromion, the location of which is once again confirmed by means of needle insertion. This location provides for good access to the subacromial space, as well as visualization, manipulation and repair of cuff tears.

Overall this portal is probably the most functional in terms of diagnostic and interventional procedures.

Structures best visualized include subacromial space, ACJ, bursal side of rotator cuff, suprascapular nerve, coraco-clavicular ligaments, extra-articular biceps, coracoid, coraco-acromial ligament, coraco-humeral ligament, rotator interval, extra-articular subscapularis and the conjoint tendon.

Structures at risk include posterior fibres of the deltoid as well as the axillary nerve.

6.7. Portal D – Superolateral portal

This portal is ideal in providing access to the biceps tendon and the subscapularis insertion, as well as the anterior labrum rim and neck. It is also known as the sub-bicipital portal and and its positioning is best achieved by advancing a spinal needle 1cm from antero-lateral edge of the acromion. Furthermore, it can be used for single or double row repairs of the anterior labrum (Casseiopia technique).

In cases of intact cuff, intra-articular access is achieved by traversing the coracohumeral ligament and the rotator interval where the ligament can be positively identified from its insertion on the coracoid.

Such approach provides for intra-articular access, but also access to the sub-coracoid space which is particularly useful in plexus exploration, subscapularis release, instrumentation of the supra-coracoid space in suprascapular nerve exposure.

Structures identified include supraspinatus, subscapularis, rotator interval, coracoid, sub-coracoid space and bursa, suprascapular nerve and intra-articular space via the rotator interval. Structures at risk of damage include anterolatral deltoid, rotator interval and biceps tendon.

6.8. Portal E – Anterior portal

Creation of this portal is an essential constituent in the diagnostic arthroscopy by allowing appropriate instrument access, thus providing for proper palpation and dynamic examination of the various shoulder structures.

The secret behind successful creation of this portal lies in the ability to visualise the biceps tendon and the rotator interval as seen through the posterior portal. To start off, a needle is inserted using the outside in technique, in an attempt to confirm the best portal position and to probe normal anatomy. The key anatomical landmark is located halfway along a line drawn from the acromion to the coracoid. It is essential to remain lateral to the coracoid in order to minimise the risk of damage to the neurovascular structures.

Following confirmation of the correct needle position via the intra-articular view, a skin incision is made with the blade advanced into the rotator interval using the needle as a guide, always being careful not to damage adjacent structures. Alternative instrument introductory methods include the use of a blunt trocar to penetrate the anterior capsule, the use of a cannulated portal or implementation of techniques which involve the use of a switching stick.

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This portal is traditionally used in anterior instrumentation but also allows for an alternative view of the biceps anchor, anterior labrum and glenoid neck, as well as view of the subscapularis, infraspinatus, teres minor, posterior labrum and capsule.

Of note is that this portal transgresses the anterior deltoid fibres as well as the rotator interval thus putting these structures at risk. Medially, one needs to be aware of the brachial plexus and axillary vessels, inferolaterally the musculocutaneous nerve and finally the cephalic vein.

7. Anatomy of the shoulder as viewed through the arthroscope

7.1. Glenohumeral joint

Once intra-articular access has been obtained with the arthroscope, a systematic examination of the shoulder is performed. This usually begins with the gleno-humeral joint. Thorough knowledge of the anatomy and normal variants is essential both to recognise pathology, and to avoid repairing a normal variant, in the mistaken belief that it is a pathological lesion.

7.2. Capsule

The capsule can be considered a watertight structure that acts to restrain the joint but permit the great range of movement of the shoulder. The volume of the joint is determined by the capsule, and varies significantly from the small, restrictive volume in patients with adhesive capsulitis, to the capacious capsule in those with connective tissue disorders or multidirectional instability.

The capsule incorporates both the tendons of the rotator cuff as they approach their insertions, and the glenohumeral ligaments, which are seen as localised thickenings. The capsule is lined by synovium, and is therefore susceptible to inflammatory disorders, malignancy and tumour-like conditions.

7.3. Glenohumeral ligament

The superior glenohumeral ligament (SGHL) is seen in 40-94% of shoulder and tends to have the most consistent anatomy of the three anterior ligaments. It usually arises at the 12 o'clock position at the supra glenoid tubercle, but can also originate from the biceps anchor and labrum. It travels parallel to the biceps tendon to insert on the medial edge of the bicipital groove and the fovea capitus.

Laterally, the SGHL joins the coracohumeral ligament, contributes to and stabilises the biceps pulley and forms part of the rotator interval. Visibility of the ligament is improved by adducting the shoulder.

The middle glenohumeral ligament (MGHL) is present in 84-92% of shoulders, and has a more variable position than the SGHL, originating from the upper part of the glenoid, the labrum, or from the origination of the SGHL. It separates from the SGHL, where it is easily visible, runs diagonally downward and across the tendon of subscapularis to insert into the lesser tuberosity. The interval between the two ligaments forms the entrance to the subscapular bursa through the foramen of Weitbrecht. This space can be utilised arthroscopically to perform subscapularis release and to approach the brachial plexus and subscapular nerves.

The appearance of the MGHL is subject to common variations, appearing either as a cord-like structure, absent or thin ligament, or a part of a Buford complex which comprises a cord like MGHL arising from the superior labrum with an absent anterior superior labrum. The variation in morphology may play a role in the aetiology of SLAP tears by contributing to the stress on the biceps anchor.

Attention should always be payed to the humeral insertion to avoid missing a humeral avulsion of the glenohumeral ligaments (HAGL). Below the MGHL is the inferior subscapular recess which corresponds to the subcoracoid foramen of Rouviere.

The inferior glenohumeral ligament (IGHL) is present in 75-93% of shoulders and comprises an anterior band (IGHLa) which originates from the glenoid between the 2 and 5 o'clock position, and a posterior band (IGHLp) which originates from the 7 to 9 o'clock position. These converge to form a sling which inserts on the humerus in the 4 to 8 o'clock position. The intervening capsular tissue between the two bands represents the axillary pouch. Due to its arrangement, the IGHL forms the main static stabiliser of the GHJ in abduction, and therefore should be carefully visualised.

7.4. Labrum

This ring of fibrous tissue forms a circumferential lip around the glenoid and provides a static role in glenohumeral stability by deepening the socket by up to 50%. It also provides an origin for the glenohumeral ligaments and biceps anchor. Anatomical variations are most commonly seen in the anterosuperior segment, with a sub-labral foramen being reported in 12-19% of shoulders.

These can be easily confused with a traumatic anterior labral injury (Bankart lesion) but need to be differentiated as the unwarranted repair can lead to a poor outcome. More inferiorly the labrum attaches to the glenoid in a consistent manner with good fixation to bone.

7.5. Rotator interval

The rotator interval (RI) is located in the anterior shoulder and is implicated in various pathologies, particularly with regard to instability and stiffness. It is triangular in shape with its base at the coracoid process, its apex at the intertubercular groove, its inferior margin the superior border of the subscapularis tendon, and its superior margin the inferior border of the supraspinatus tendon.

The contents of the (RI) are the SGHL, biceps tendon, the coracohumeral ligament (CHL), and the glenohumeral joint capsule. The function of the RI and its components is to restrict inferior and posterior translation of the humeral head via the SGHL and CHL as well as limiting external rotation.

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Its lateral components maintain the stability of the biceps tendon. The RI also maintains negative intra-articular pressure. Lesions of the RI have been classified into two types.

Type I lesions are those leading to a contracture of the RI e.g. adhesive capsulitis, and type II lesions lead to laxity.

7.6. Coracohumeral ligament

This trapezoid structure is located in the rotator interval. It originates from an extra-articular location via two roots; a ventral root arising from the anterior part of the dorsolateral coracoid, and a dorsal root from the base of the coracoid. Both roots lie beneath the CA ligament, after which the CHL takes a course parallel to the long head of biceps tendon and through the RI. Its insertion laterally is subject to variation, its most common position being into the RI itself. Occasionally the CHL inserts into the supraspinatus tendon, subscapularis tendon, or both.

The CHL is thought to represent a remnant of a redundant pectoralis minor ligament, but is thought to contribute to limiting external rotation with the arm in abduction, as well as providing resistance to inferior translation of the humeral head. It is also thought to be the primary structure affected by adhesive capsulitis and therefore surgical release should address this.

7.7. Biceps tendon

The long head of biceps tendon (LHBT) is an intra-articular structure but remains extra-synovial. It is enveloped in a synovial sheath which terminates at the distal end of the bicipital groove in a blind pouch. The importance of the LHBT is in providing a useful anatomical landmark for orientation, but also is a source of of pathology and symptoms.

The biceps tendon comprises three sections: the biceps anchor, the intra-articular tendinous portion, and the pulley system.

The biceps anchor originated from the supraglenoid tubercle and the glenoid labrum, and is the site of the Superior Labral Anterior Posterior lesion (SLAP), commonly seen in overhead throwing athletes and after traction injuries. The anchor is best visualised with the arm placed in abduction and external rotation using the Peel back test.

From its origin, the LHBT passes obliquely along the RI before exiting through the pulley system, this intra-articular section being on average 100mm in length. It is stabilised at is exits the shoulder via the pulley system prior to entering the bicipital groove. The pulley has four components, comprising the subscapularis tendon forming the floor, the CHL which forms the roof and lateral wall along with a tendinous slip of the supraspinatus tendon, and the SGHL forming the medial sling.

The supraspinatus and subscapularis tendons should be carefully assessed in cases of biceps tendon instability, which can be dynamically tested by performing internal and external rotational movements. Dislocation is manifested by the tendon moving completely out of its groove.

7.8. Rotator cuff

The rotator cuff tendons lie beneath the deltoid and are vital in enabling movement and providing stability to the shoulder joint. The cuff comprises four muscles - supraspinatus, infraspinatus, subscapularis and teres minor.

Subscapularis is the largest of the rotator cuff muscles, originating from the upper 2/3 of the anterior surface of the scapula, and condensing laterally to pass beneath the coracoid. The upper 2/3 in mostly tendinous, whilst the lower third remains muscular to its attachment point on the lesser tubercle adjacent to the biceps tendon. Internal rotation improves visibility of the insertion, which should be inspected carefully for evidence of a tear in the presence of an anterior pulley rupture, which can be classified as follows:

i. Partial lesion only involving the upper 1/3 of subscapularis

ii. Complete lesion of the upper 1/3

iii. Complete lesion of the upper 2/3

iv. Complete lesion of the tendon but the head remains centred and Goutallier ≤ 3

v. Complete lesion with eccentric head position, coracoid impingement and Goutallier ≥ 4 (Goutallier grades refer to fatty degeneration of the muscle belly)

The supraspinatus muscle arises from the supraspinatus fossa via two muscle bellies to insert onto the greater tuberosity. The anterior fusiform belly gives rise to a central tendon which migrates anteriorly and forms an external extra-muscular tendon comprising 40% of the overall width of the tendon. The posterior 60% arises from a unipennate muscle belly. The difference in sizes results in 2.88 times greater stress in the anterior portion, which may be the cause for this being a common site of tearing.

The supraspinatus tendon is divided into four structurally independent subunits:

Tendon proper: extends from the musculotendinous junction to 2cm medial to the greater tuberosity. The collagen fibres in this region are parallel.

Rotator cable: a densely packed band of unidirectional collagen fibres extending from the CHL anteriorly to the inferior border of infraspinatus posteriorly which surrounds the thinner crescent, acting as a stress shield and causing maintenance of function even when there is a tear of the rotator crescent.

Fibrocartilage attachment: extends from the tendon proper to the greater tuberosity.

Capsule: composed of thin collagen sheets with a uniform fibre alignment.

Supraspinatus inserts into the superior and middle facets of the greater tuberosity, extending 1mm from the articular surface to a distance approximately 16mm lateral to it. This large footprint forms the basis of the double row technique of rotator cuff repair.

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The thick, triangular, multipennate infraspinatus arise from the infraspinous fossa, converging into a tendon that passes across the posterior aspect of the glenohumeral joint. The tendon overlaps and joins the posterior border of the supraspinatus tendon, inserting into a trapezoidal footprint on the middle facet of the greater tuberosity with average dimensions of 29 ° ¡ 19mm, providing a large base for tendon to bone healing. The footprint narrows inferiorly, and the gap thus created forms the bare area.

Teres minor originates from the dorsal surface of the lateral border of the scapula and the fascia of infraspinatus. As it passes laterally, posterior to the shoulder joint, it forms its tendon which comprises part of the capsule and inserts onto the inferior facet of the greater tuberosity. The inferior border of the teres minor tendon forms the superior border of the quadrilateral space which transmits the posterior circumflex humeral artery and axillary nerve.

7.9. Glenoid

The glenoid has three components: bone, articular cartilage and the labrum. It is shaped like an inverted comma with a broader inferior portion, and a thinner superior tail. The average vertical dimension is 35mm and horizantal dimension is 25mm. 75% of glenoids are retroverted with regard to the plane of the scapular, with 15° superior tilt. The glenoid fossa is covered by hyaline cartilage, which is thicker at the periphery than the centre in order to deepen the concavity. 50% of the depth of the glenoid is due to the bony structure, the remaining 50% is formed by the labrum. The glenoid should be inspected in its entirety, to include the labrum.

7.10. Humeral head

The humeral head forms 1/3 of a true sphere, with the articular surface orientated 25-35° retrovertely and 130° superiorly. The anterior border is limited by the lesser tuberosity and the lateral border by the greater tuberosity. Between the two lies the inter-tubercular groove.

A bare area exists on the posterolateral humeral head adjacent to the infraspinatus tendon which can be confused with a Hills-Sachs lesion. Visualisation of the humeral head requires it to be rotated, abducted and adducted to ensure an adequate inspection. Stability can be assessed by performing translational movements.

7.11. Subacromial space / Subacromial bursa

The subacromial bursa lies between the anterior rotator cuff and the acromion and is a synovial-lined sac that acts to reduce friction and improve gliding between the rotator cuff and coraco-acromial arch.

The bursa lies in the anterior half of the subacromial space and access is best obtained by directing the scope anteriolaterally to the corner of the acromion. Bursectomy is often required to improve visualisation of the rotator cuff, which is inspected for tears, their size, shape, tendon involvement and the quality of the tendon involved.

7.12. Coracoacromial Ligament (CAL)

This strong triangular ligament forms the anterior part of the coracoacromial arch. It is separated from the rotator cuff by the subacromial bursa and is strongly associated in impingement syndrome.

It originates from a large area on the lateral aspect of the coracoid and narrows to insert on the anteromedial and anteroinferior surfaces of the acromion. Often distinct bands can be seen anterolateral and posteromedially. It is especially important to fully visualise the anterolateral band as spurs occur and cause impingement.

7.13. Coracoid

The coracoid is found at the base of the neck of the glenoid and projects anteriorly before hooking anterolaterally and flattening, providing the site of attachment of several tendons and ligaments.

Superiorly are the coracoclavicular ligaments (conoid and trapezoid), inferiorly lies the conjoint tendon, laterally the CHL and CAL, and inferomedially the pectoralis minor tendon. Inferomedial to the coracoid lie the neurovascular structures of the plexus and axillary vessels. Passing directly beneath the coracoid is the tendon of subscapularis. The coracoid has been described as the lighthouse of the shoulder, and helps to orientate the surgeon.

7.14. Acromion

The acromion forms from three ossification centres, which usually fuse by the age of 25. Failure of any of these centres leads to an os acromiale, which is an incidental finding in 8%. The acromion is the insertion point of the coracoacromial ligament and forms an articulation with the clavicle. The shape of the acromion is though to predispose to impingement syndrome and rotator cuff pathology, with three types described by Bigliani:

i. Flat

ii. Curved

iii. Hooked

Type III are thought to be associated in the aetiology of rotator cuff tears.

7.15. Acromioclavicular joint

The acromioclavicular joint (ACJ) is a diarthrodial joint with the articular surfaces separated by an intra-articular disc. The joint is usually orientated superolateral to inferomedial. The lateral end of the clavicle is convex and articulates with the concave acromion. The joint is covered by a thick capsule, especially on its anterior, medial and superior surfaces and identifying its location is facilitated by applying pressure to the clavicle and observing movement of the joint.

http://dx.doi.org/10.5772/55005

8. Common procedures

8.1. Arthroscopic subacromial decompression

Arthroscopic subacromial decompression (ASD) is one of the most commonly performed operations of the shoulder. The arthroscopic technique bares little resemblance to the original open acromioplasty described by Neer. The indications for ASD are controversial. There are many causes for an impingement syndrome in the shoulder, and few are relieved by ASD. The aim of ASD is to convert a pathological coracoacromial arch into a physiological one. Patients with primary extrinsic impingement syndrome of the anterior acromion, coracoacromial arch and acromioclavicular joint on the underlying biceps tendon and rotator cuff, and those with chronic secondary impingement due to tendinous rotator cuff degeneration resulting in the formation of subacromial osteophyte formation are the most responsive to ASD.

ASD should be considered only after failure of conservative management. This involves the use of non-steroidal anti-inflammatories, physiotherapy for scapular, rotator cuff and range of movement exercises, and activity modification. Those with normal bony anatomy usually respond well. Relative contraindications to ASD include patients with massive rotator cuff tear and significant underlying glenohumeral arthritis likely to require arthroplasty. Dispute remains as whether or not to perform ASD during rotator cuff repair, with good evidence for both sides of the argument, and therefore most surgeons decompress where there is preoperative clinical or arthroscopic evidence of impingement.

The acromion and its underside can be preoperatively visualised radiographically with Neer's supraspinatus view. Bigliani described three distinct anatomical shapes: type 1 - flat (divergent), type 2 - curved (congruent), and type 3 - hooked (stenotic). The hooked acromion described as type 3 is more likely to cause an impingement and is suitable for ASD.

The arthroscopic technique for subacromial decompression was first described by Johnson in 1986. In contrast to the open procedure, there is no requirement to remove full thickness bone from the anterior acromion which therefore spares detachment of the deltoid fascial attachment or resection of the coracoacromial ligament. The results of ASD are therefore superior to open acromioplasty. The aim of surgery is to create a type 1 or 2 acromion, both of which are physiological in their shape, and likely to relieve the impingement syndrome. This must be performed without damaging the coracoacromial arch which can lead to destabilisation of the glenohumeral joint and anterior subluxation of the head. This only rarely occurs in ASD, though was more common with an open acromioplasty due to the reforming of the coracoacromial ligament after partial resection. The ACJ can also contribute to pain, particularly with distal clavical or medial acromion osteophyte formation and can lead to persistent pain postoperatively if neglected.

ASD is performed following a full diagnostic arthroscopy. Most surgeons examine the glenohumeral joint before repositioning in the subacromial space with a posterior portal. Instruments are usually then introduced through the lateral portal. The soft tissue on the underside of the acromion is firstly debrided with cautery ablation or a shaver. Care must be taken to remain on the underside of bone, and not migrate laterally into the fibres of deltoid, which can be highly vascular. A burr is introduced to start debridement at the anterolateral corner of the acromion, before progressing medially and posteriorly, to include the ACJ and distal clavicle if required. The diameter of the burr is a guide as to how much bone has been resected. Care must be taken not to remove full thickness bone anteriorly as this will lead to detachment of deltoid. The acromion should be resected to a smooth surface with an even taper.

The most common complications associated with ASD include inadequate or uneven resection leading to persistence of symptoms, injury to deltoid or rotator cuff, and haemorrhage. Post operatively there needs be no restriction on passive range of movement. Pendulum exercises can be started immediately, with physiotherapy continuing the preoperative exercises. Return to light duty is usually within 1 to 2 weeks, but heavy labour should be delayed for 6 to 12 weeks.

8.2. Excision lateral end of clavicle

The acromioclavicular joint (ACJ) is exposed to substantial forces during arm loading, and is therefore susceptible to degeneration. The ACJ is a diarthrodial joint with hyaline cartilage articulations partly separated by a fibrocartilage disc. It however degenerates to a fibrocartilaginous joint by the age of 40. Stability of the ACJ joint is achieved by a combination of the dynamic constraints of the deltoid and trapezius crossing the joint, and the static acromioclavicular and coracoclavicular ligaments. Degeneration of the ACJ is secondary to either degeneration or instability. Weightlifters are a group of individuals susceptible to early degeneration due to a stress reaction in the distal clavicle, known as distal clavicular osteolysis.

Presentation can be acutely, following an injury resulting in instability and consequent pain and mechanical symptons, or more chronically due to the insidious degeneration and gradual loss of function with arthritis. Mild to moderate symptoms can be treated conservatively initially, with activity modulation, and corticosteroid injection. Injection of local anaesthetic can be useful as a diagnostic procedure to confirm diagnosis. When symptoms do not resolve, and impede on a patients lifestyle, excision of the lateral clavicle should be considered. Relative contraindications include cystic disease within the distal clavicle, and instability that may be more suitable to reconstruction.

Routine diagnostic arthroscopy should always initiate the procedure though a posterior portal. If subacromial decompression is anticipated a lateral portal is used to provide access for instrumentation. Bursectomy is required to visualise the ACJ, and may be assisted by the use of a needle placed into the joint or by manual displacement. Cautery is then used to strip the inferior joint capsule from the joint. An accessory anterior portal is often useful to provide access to the joint and will allow exposure of the distal clavicle. Care must be taken to expose the superioanterior and posterior corners of the joint whilst preserving the superior acromioclavicular ligament to avoid iatrogenic instability. Once exposure is completed, resection is performed with the use of a burr. 8-10 mm of resection usually relieves impingement whilst preserving the medial coracoclavicular ligaments. Resection can be estimated by the placement of an instrument of known diameter.

Postoperatively the shoulder only requires immobilisation for comfort, and range of movement can be initiated without delay. Normal activities can be resumed within 6 weeks, although heavy lifting should be delayed for at least 12 weeks to avoid stretching the weakened acromioclavicular ligaments.

9. The future of shoulder arthroscopy

The future of arthroscopic shoulder surgery is already beginning to flourish through advances in both the biological as well as its technological sectors. Tissue engineering is already being implemented in cartilage reconstructive/reparative surgery. Muscle and tendon engineering has become possible with numerous studies under way to explore the potential.

Recent advances in micro-electronics technology has resulted in the development of needle arthroscopes, approaching the size of an 18 gauge needle, allowing some of the procedures to be performed under local anaesthetic, sometimes in the clinic setting.

Most current research is looking at nanobot injection into the joint. Their function relies on manipulation of molecules of ethylene monomer, directing them towards areas where wear and tear has manifested itself. This results in a polymerisation reaction locally, allowing high density molecules to form.

10. Summary

Shoulder arthroscopy has not only provided us with another extremely significant surgical tool used in both diagnosis and treatment of shoulder conditions, but also an improved well rounded understanding of shoulder anatomy, and mechanics of different diseases which were previously misdiagnosed or undiagnosed altogether e.g. SLAP lesions.

The fact that this technique requires the ability to think as well as the manual dexterity to operate in a three dimensional perspective, always appreciating surrounding anatomy, depth and economy of movement, are all constituents of a rather steep but rapidly evolving learning curve.

Author details

Jeremy Rushbrook*, Panayiotis Souroullas and Neil Pennington

York Hospital Foundation Trust, UK

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