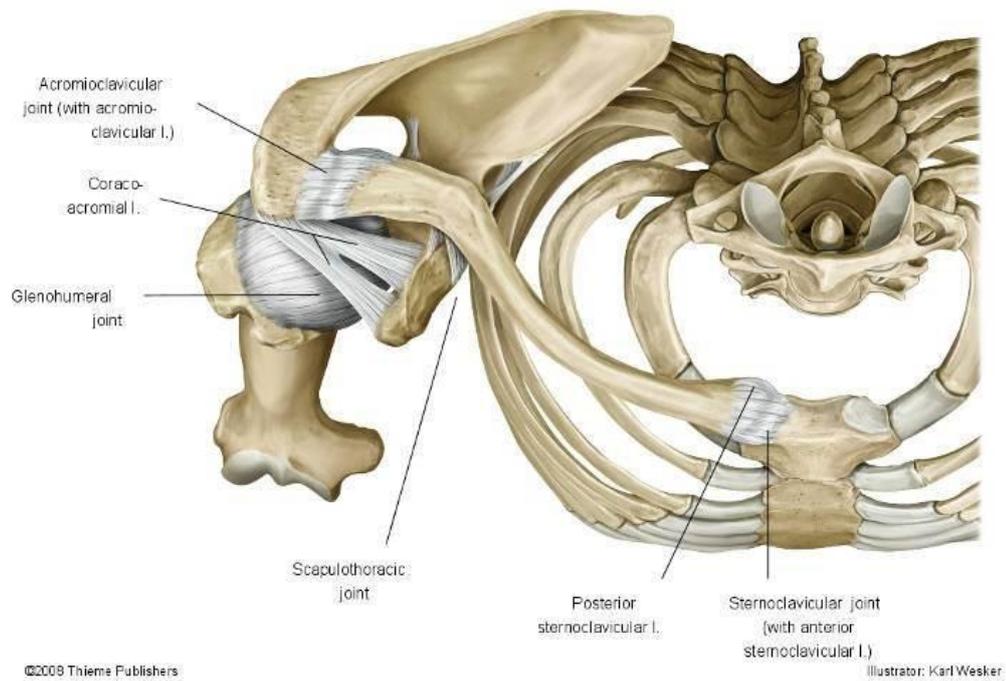


The Shoulder

Structures, functions, disorders, treatments



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Contents

The Shoulder	1
Bones of Shoulder Region	1
Joints of Shoulder	1
The glenohumeral joint	2
The acromioclavicular joint	4
The sternoclavicular joint.....	5
Muscles of the shoulder	7
Rotator cuff muscles	7
Muscles from the trunk to the scapula.....	8
Muscles from the scapula to the arm.....	9
Long muscles of the shoulder.....	10
Nerve root names values to shoulder and arm	12
The Axilla.....	14
Brachial Plexus.....	15
Movements of the shoulder.....	20
Dysfunctions of the Shoulder.....	15
Dislocations.....	15
Relocation of Dislocations.....	20
Analgesic Position 1.....	20
The Cunningham Method.....	21
Kocher's Method	23
Analgesic Position 2.....	25
Scapula Manipulation Technique	27
Bankart Lesion.....	28
Hill-Sachs Lesion.....	29
Acromioclavicular Separations	30
Sternoclavicular Joint Dislocations	32
Frozen Shoulder.....	34
Subacromial Bursitis	41
Ruptured Long Head of Biceps	42
Subluxation of the Bicipital Tendon	44
Manipulations of the Shoulder Region	46
Glenohumeral Joint.....	46
Acromioclavicular joint.....	46
Bicipital Tendon.....	47
Sternoclavicular Joint.....	47

Figure 1 The Shoulder (Pectoral) Girdle.....	1
Figure 2 The Pectoral Girdle from above	2
Figure 3 The Glenohumeral Joint.....	2
Figure 4 The Glenoid Fossa	2
Figure 5 Dissection of lateral view of disarticulated glenohumeral joint showing: G - glenoid, HH - humeral head, LHB - Long Head of Biceps	3
Figure 6 Glenohumeral Capsule.....	3
Figure 7 Acromioclavicular joint and Sternoclavicular joint, with their respective ligaments.....	5
Figure 8 Coracoclavicular ligaments.....	5
Figure 9 Sternoclavicular joint with ligaments and intra-articular disc.....	6
Figure 10 Shoulder girdle, seen from above	6
Figure 11 - Rotator Cuff muscles.....	7
Figure 12 Rotator cuff actions on scapula.....	7
Figure 13 Pectoralis minor	8
Figure 14 Serratus Anterior.....	8
Figure 15 Serratus Anterior, seen from above	8
Figure 16 Serratus anterior, in relation to Subscapularis.....	8
Figure 17 Periscapular muscles: rhomboids, levator scapulae, and trapezius	9
Figure 18 Movements of the scapula.....	9
Figure 19 Coracobrachialis.....	9
Figure 20 Teres Major	9
Figure 21 Triceps.....	10
Figure 22 Biceps brachii	10
Figure 23 Pectoralis Major	10
Figure 24 Latissimus Dorsi	10
Figure 25 Deltoid	11
Figure 26 Schematic of shoulder muscles showing directions of pull	13
Figure 27 Diagram demonstrating the borders of the axilla	14
Figure 28 the axilla - seen from above	15
Figure 29 Brachial Plexus - showing Roots, Trunks, Divisions, Cords, and Branches	16
Figure 30 Brachial plexus showing the cords in relation to the axillary artery.....	16
Figure 31 Diagram showing scalenes on side of cervical spine, with emerging roots of brachial plexus	17
Figure 32 Brachial Plexus in relation to local bony anatomy.....	17
Figure 33 Diagram showing cords of brachial plexus in relation to axillary artery, as it enters the arm	18
Figure 34 Diagram of posterior axilla, seen from behind, showing spaces for emerging structures... ..	18
Figure 35 Schematic, using fingers, demonstrating posterior spaces of axilla	19
Figure 36 Posterolateral view of shoulder showing quadrangular space	19
Figure 37 Abduction of the arm.....	20
Figure 38 Positions of the scapula with abduction	20
Figure 39 Muscles of shoulder before abduction.....	21
Figure 40 Shoulder in abduction - muscles moving scapula.....	21
Figure 41 Shoulder Flexion Figure 42 Shoulder Extension.....	22
Figure 43 Shoulder Abduction Figure 44 Shoulder External and Internal Rotation.....	22
Figure 45 Glenohumeral tissue relationships.....	15
Figure 46 Injuries to Shoulder on Outstretched Arm	17
Figure 47 Shrugging Abduction	17
Figure 48 Drop Sign of Rotator Cuff Tear	17
Figure 49 4 Types of Shoulder Dislocation	18
Figure 50 Subcoracoid Dislocation X-Ray and diagram	18

Figure 51 Subglenoid Dislocation X-Ray and diagram	19
Figure 52 Subclavicular dislocation X-ray	19
Figure 53 Inferior Dislocation (Luxatio Erecta)	19
Figure 54 Relocation of dislocation 1	20
Figure 55 Cunningham Method of Shoulder Relocation	22
Figure 56 Kocher's Method of Shoulder Relocation	23
Figure 57 Analgesic Position 2	25
Figure 58 Scapular Manipulation Technique.....	27
Figure 59 Bankart Lesion.....	28
Figure 60 Hill-Sachs Lesion.....	29
Figure 61 Hill Sachs Lesion on X-Ray	29
Figure 62 Acromioclavicular dislocations	30
Figure 63 Dislocation AC Appearance	31
Figure 64 Acromioclavicular dislocation X-Ray	31
Figure 65 Sternoclavicular Joint	32
Figure 66 Sternoclavicular dislocation - Appearance	33
Figure 67 Sternoclavicular Dislocation X-Ray	33
Figure 68 Early Frozen Shoulder	34
Figure 69 Frozen shoulder joint compared with normal.....	35
Figure 70 Limitation of Internal Rotation.....	35
Figure 71 Classical presentation of Frozen Shoulder with Bilateral Active Flexion	36
Figure 72 Limitation of External Rotation	36
Figure 73 A protruding shoulder blade	36
Figure 74 Pendulum Exercise	37
Figure 75 Pendulum Exercise 2	38
Figure 76 External rotation	38
Figure 77 The Door Pulley	38
Figure 78 Adduction exercise.....	38
Figure 79 Towel exercise.....	39
Figure 80 Mobility exercises for shoulders	39
Figure 81 Kung Fu Exercises for shoulders	40
Figure 83 Subacromial Bursitis Painful Arc of Movement	41
Figure 84 Diagram of Rupture of Long Head of Biceps	43
Figure 85 Physical Appearance of Ruptured Long Head Biceps	43
Figure 86 Bicipital Tendon in Bicipital Groove	44

The Shoulder

The 'shoulder' is a very general term including all the structures of the anatomy of the region. It consists of a girdle of structures around the top of the thoracic cage.

Bones of Shoulder Region

The bones of the region are:

- **Scapula**
- **Clavicle**
- **Sternum**
- **Thoracic cage**
- **Humerus**

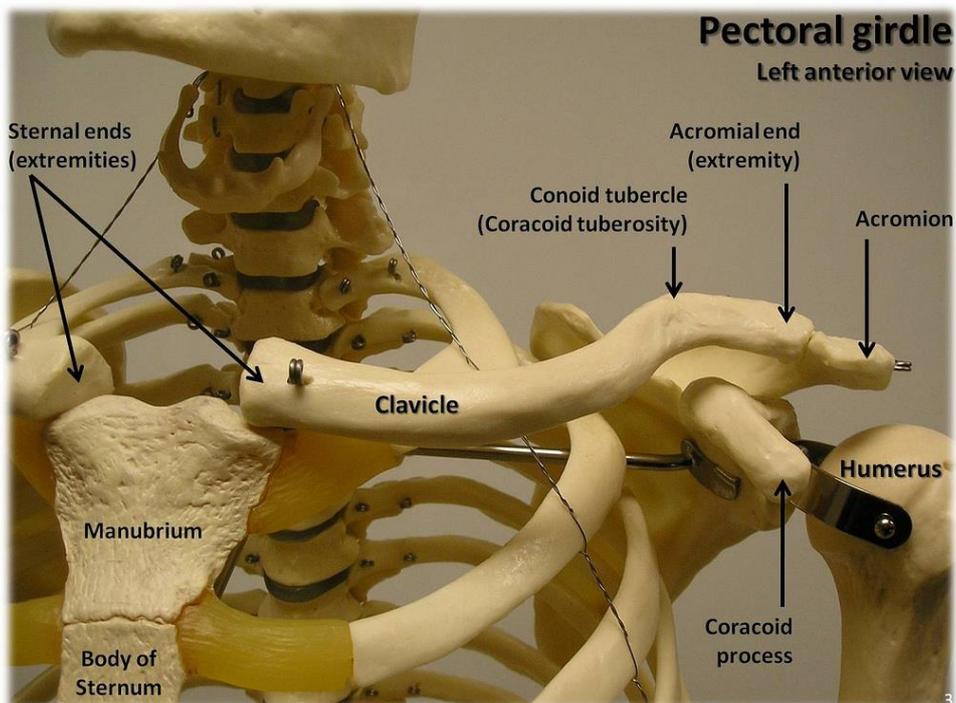


Figure 1 The Shoulder (Pectoral) Girdle

Joints of Shoulder

The joints of the region are:

- **Glenohumeral joint**
 - Between the proximal end of the humerus and the glenoid fossa of the scapula
- **Acromioclavicular joint**
 - Between the distal end of the acromion and the lateral end of the clavicle
- **Sternoclavicular joint**
 - Between the manubrium and the medial end of the clavicle
- **Scapulothoracic articulation**
 - This is not a joint, per se, but the movement of the scapula around the thoracic cage

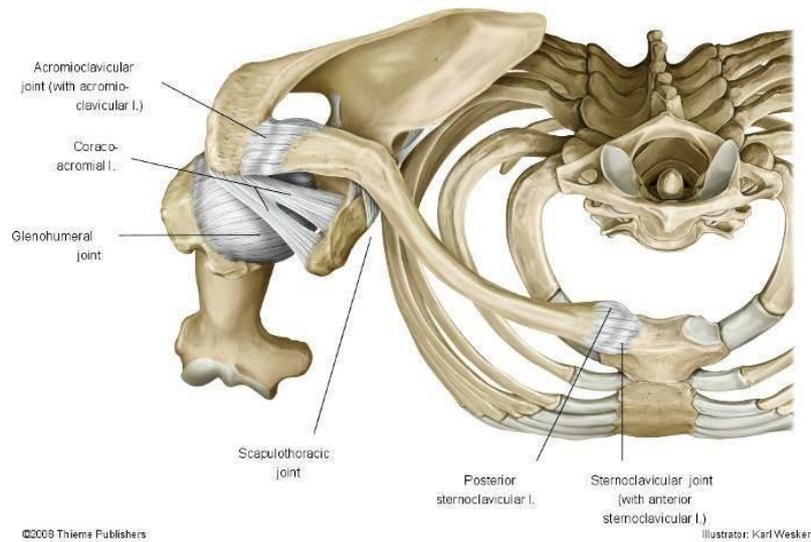


Figure 2 The Pectoral Girdle from above

The glenohumeral joint

The Glenohumeral joint is a ball and socket joint and is between the head of the humerus and the glenoid fossa of the scapula; it consists of a large ball sitting in a small socket. There are few ligaments here, per se, and the joint is stabilised mainly by muscles.

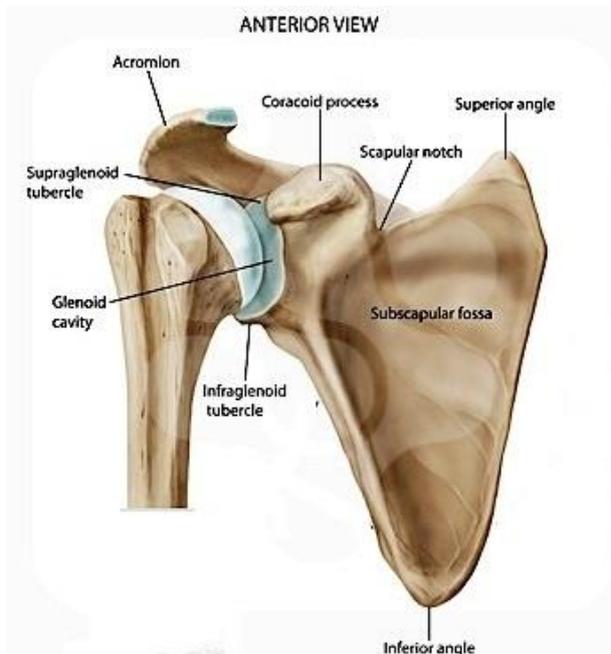
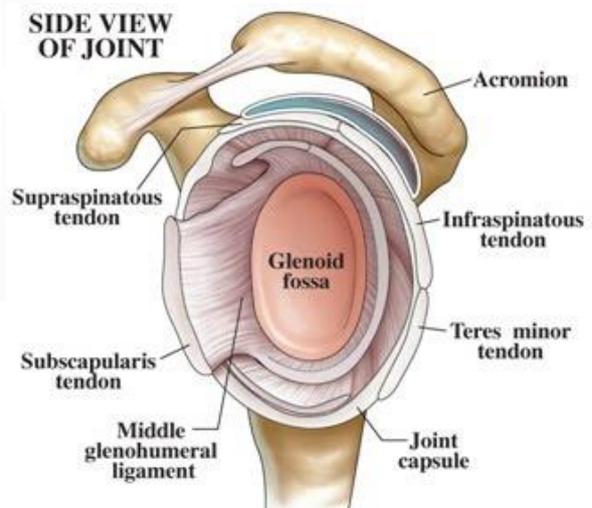


Figure 4 The Glenoid Fossa

Figure 3 The Glenohumeral Joint

The glenoid fossa is made deeper, and more stable, by the presence of a glenoid labrum, a ridge of cartilage around its perimeter, making it deeper. The joint is stabilised by the rotator cuff muscles



The glenohumeral joint itself is aligned in the vertical plane. This contributes to the great mobility of the joint, but also suggests an inherent instability as weight bearing through the joint will tend to cause dislocation of the humeral head inferiorly. The stability of the joint is

increased by the glenoid labrum, thickening of cartilage around the rim of the glenoid fossa, increasing the depth of the joint and the rotator cuff muscles.

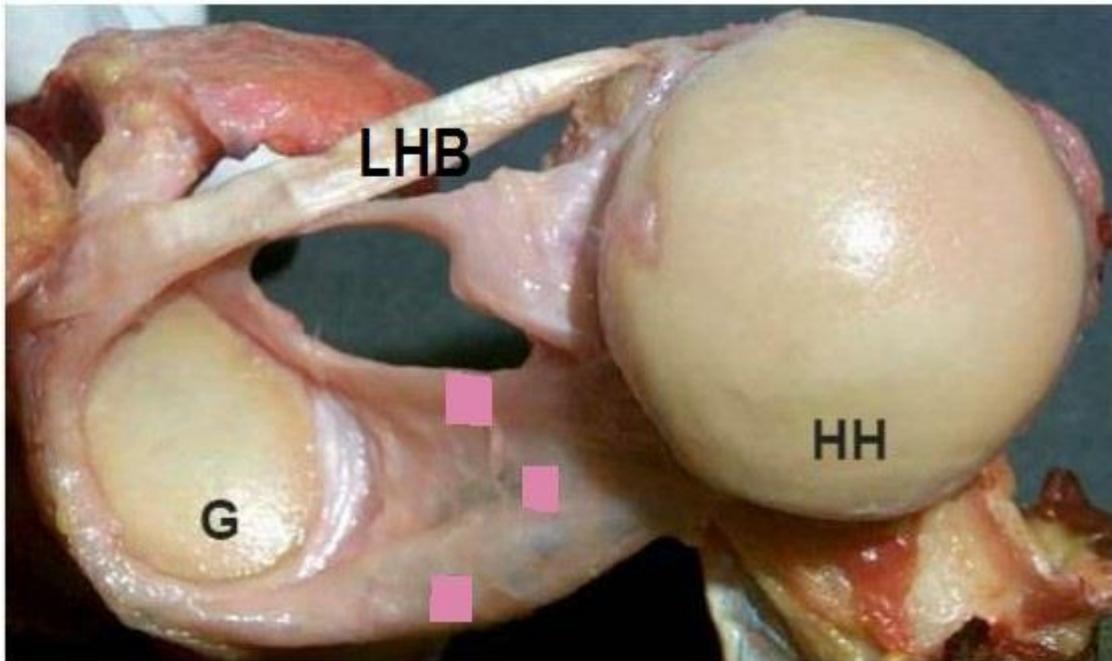
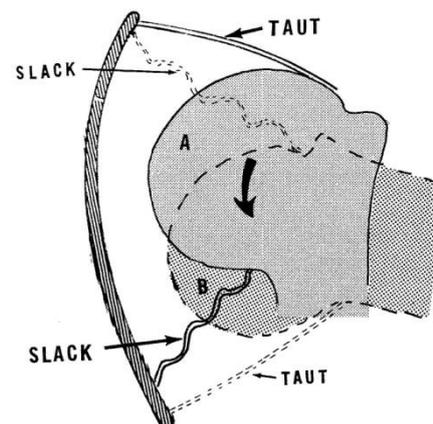


Figure 5 Dissection of lateral view of disarticulated glenohumeral joint showing: G - glenoid, HH - humeral head, LHB - Long Head of Biceps

Functional stability of the glenohumeral joint is completely dependent upon the synergism of the local ligaments and the musculotendinous units. Because of its vertical alignment, the shoulder is very unstable from just a bony standpoint; the only true bony attachment of the arm to the body is the joint of the clavicle to the sternum. The rest is purely muscular.

Figure 6 Glenohumeral Capsule

Fig 6 - The glenohumeral capsule. It originates from the glenoid labrum and attaches to the top of the humerus. In the static arm, it prevents downward motion. With the arm dependent (A), the humerus is supported by a taut superior cable; the inferior capsule is slack. As the arm abducts, the head descends in the glenoid fossa (B) and the inferior capsule becomes taut. If the inferior capsule become contracted, a *frozen shoulder* can result.



15 muscles move and stabilise the scapula. 9 muscles provide glenohumeral motion and 6 support the scapula of the thorax. The combination of these muscles and joints allow for maximal rotation with minimal stress on the proximal fixation (the S/C joint).

The clavicle is a 'S' shaped bone and holds the scapula such that its angle to the thoracic cage is about 30°; the plane of the scapula. [This plane can be located by placing the ulnar border of the hand on the spine of the scapula along the body of supraspinatus; the angle between the hand and the coronal plane will be 30°]. The plane of the scapula is where the rotator cuff muscles are aligned. The forward angle of the glenoid fossa is also one of the reasons that glenohumeral dislocations are more anterior than posterior. People with pain

have muscular dysfunction that alters their kinematics. Here it is important to observe how a person raises their arms overhead, seeing their plane of motion as well as synergy of function.

The anterior capsular mechanism is comprised of 4 interrelated structures:

- **Subscapularis tendon**
- **Glenoid labrum**
- **Anterior capsular ligaments** - Z-shaped across the capsule
 - **Coracohumeral**
 - **Glenohumeral**
 - **Superior, middle and anterior inferior glenohumeral.** The anterior inferior glenohumeral ligament is the most important in the shoulder. The gross and microscopic structure of the AIGHL complex reveals a distinct histological and functional arrangement that appears to provide support of the abducted humeral head in both internal and external rotation. The AIGHL is the main static stabiliser to both anterior and posterior motion.
- **Anterior synovial pouches and bursae:** the subdeltoid (subacromial) bursa is the largest bursa in the body

These ligaments are likened to pleated horizontal folds in a fan shaped arrangement. Here, an opening may exist between the superior and middle ligaments. A thin capsular layer may cover this opening. The superior capsular ligament is damaged by external rotation and mid-abduction (e. reaching into the back of the car)

The capsule of the joint is lined with synovial tissue that may or may not come down to include the bicipital groove and the bicipital tendon (long head of biceps). The bursae that are most prevalent are:

- **The predeltoid bursa**
- **The biceps tendon bursa**
- **The subacromial bursa**

These three areas are the main sites of the usual irritation that the practitioner sees in the shoulder.

Females are predisposed to increased glenohumeral movement or laxity. If they have bad mechanics, the problem magnifies. The worst age for shoulder instability is approximately 13-14 years of age, when rapid growth patterns are developing, and the neuro-musculotendinous system is not yet fully developed.

The acromioclavicular joint (A/C joint)

This is gliding, synovial, joint between acromion of the scapula and the lateral end of the clavicle. An articular disc may be present in a percentage of the population. Here the lateral end of the clavicle is stabilised (held down) by ligaments between it and the scapula. There is also a bursa here between the acromion and the muscle supraspinatus

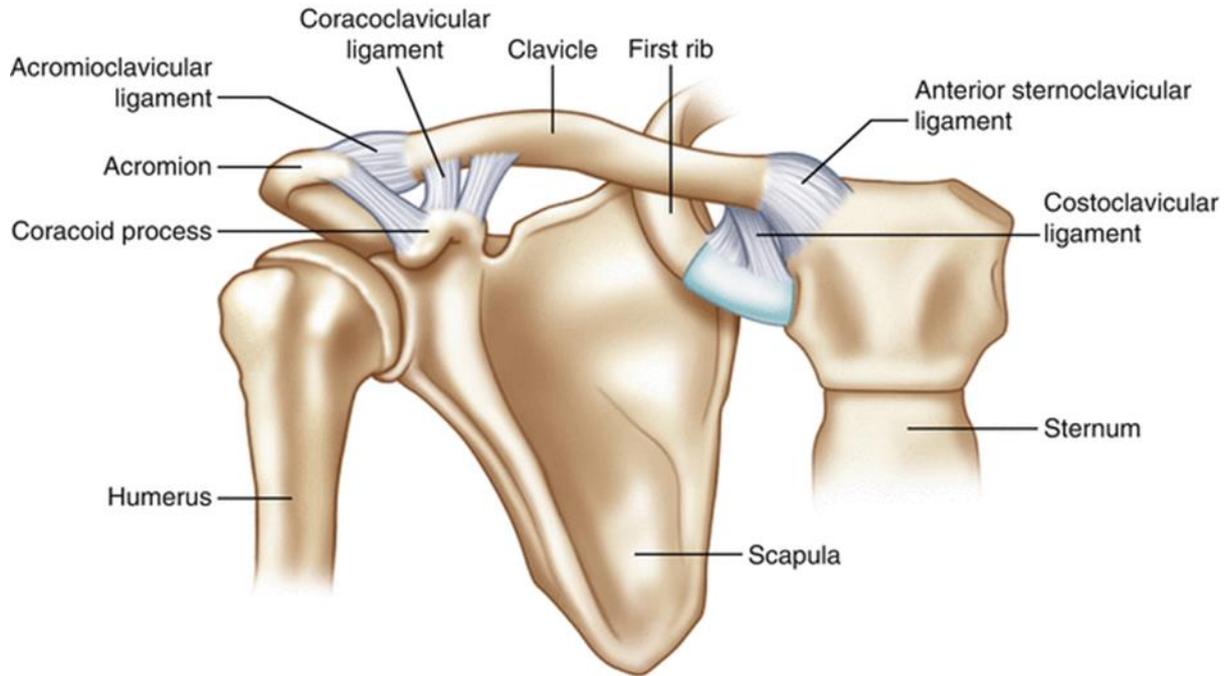


Figure 7 Acromioclavicular joint and Sternoclavicular joint, with their respective ligaments

The diagram (Fig 7) demonstrates both the A/C and S/C joint, along with their ligamentous structures. The clavicle has ligaments at both its medial and lateral ends, with the first rib and coracoid process respectively. Their mutual function is to hold the clavicle down and stop it dislocating superiorly.

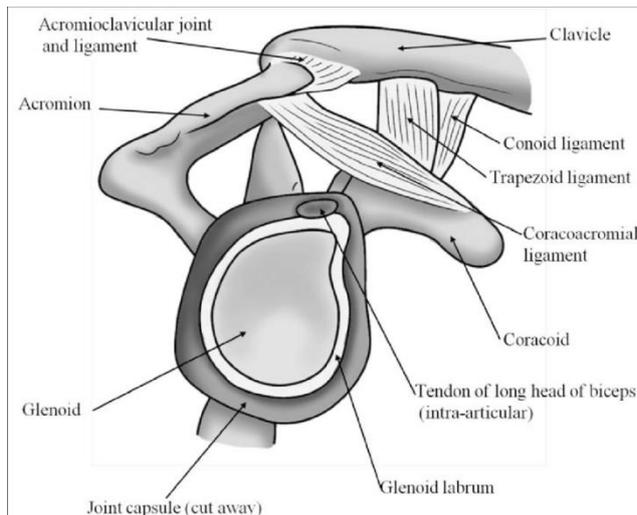


Figure 8 Coracoclavicular ligaments

The stability of the A/C joint is maintained by ligaments, the primary ones being the **acromioclavicular** and **coracoclavicular** ligaments. The coracoclavicular ligament has two distinct parts:

- **Trapezoid** - at the front
- **Conoid** - at the back

The A/C joint is frequently injured by falling on an outstretched arm, or onto the point of the shoulder.

A fall on an outstretched arm drives the acromion up and away from the clavicle, while a fall on the shoulder can drive the clavicle up and away from the acromion. Persistent problems may result in damage of the intra-articular disc or contribute to degenerative joint disease.

The sternoclavicular joint

This is a saddle joint between the medial end of the clavicle and the sternum. It has limited movement that extends to about 25° of clavicular rotation and 40° elevation. This joint does serve as the only true bony connection between the shoulders to the thorax. Thus, this complete structure is called the clavicular strut and functions much like the suspension of a car. The joint is supported by the **sternoclavicular** and **costoclavicular** ligaments (Fig 8), the latter of which holds it down.

Both the sternoclavicular and acromioclavicular joints both have an intra-articular disc, a structure found in some synovial joints that experience significant compressive forces, to facilitate movement therein.

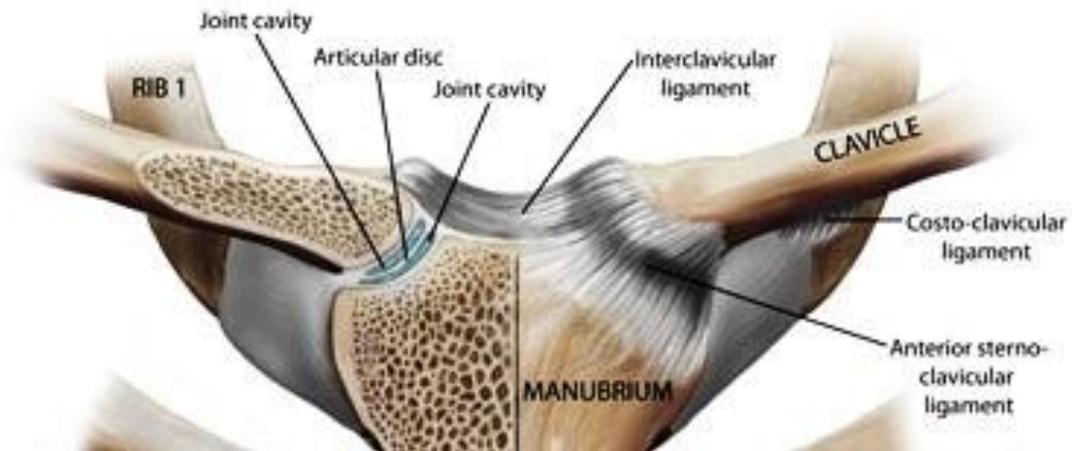


Figure 9 Sternoclavicular joint with ligaments and intra-articular disc

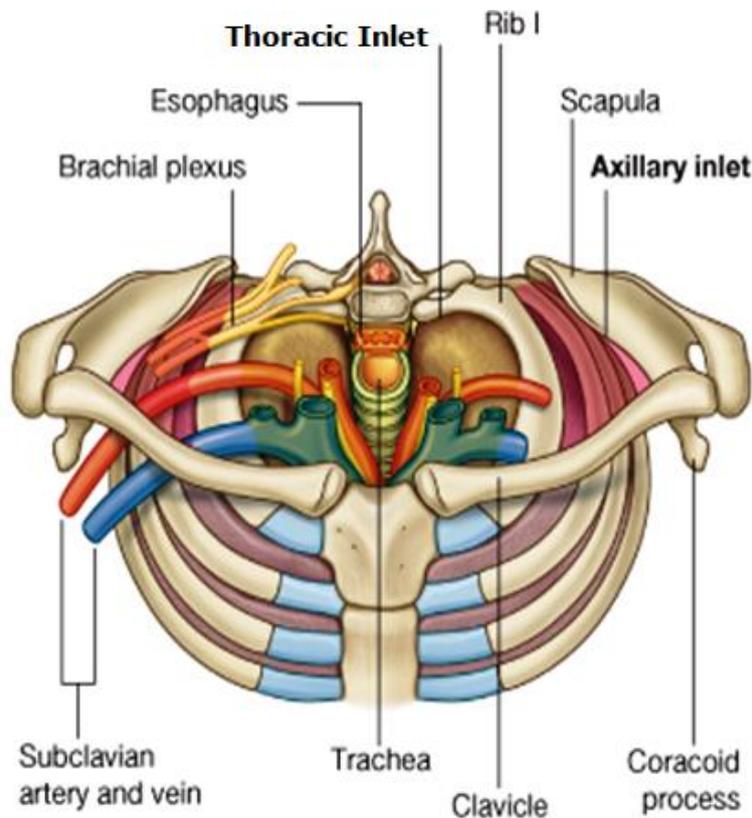


Figure 10 Shoulder girdle, seen from above

The S/C joint is not a joint that is usually injured in an athletic setting, though with the advent of artificial surfaces, they have become more prevalent. When the axial load is aligned correctly, the force is transmitted through the clavicle and the S/C joint may be disrupted. This injury in an adolescent might result in a fractured clavicle instead of a separated S/C joint. An anterior dislocation is the most common and may occur traumatically. Posterior dislocations are less common and, requiring more kinetic force, are associated with higher degrees of soft tissue trauma (e.g. oesophagus, jugular vein and carotid artery).

Muscles of the shoulder

Muscles that move the shoulder are anatomically divided into several groups:

- **Rotator cuff muscles**
- **Muscles from the scapula to the trunk**
- **Muscles from the scapula to the arm**
- **Long muscles**

Rotator cuff muscles

As can be seen in Fig 4, the rotator cuff muscles form a musculotendinous cuff around the glenohumeral joint. They all have their own respective movements of the arm on the scapula, but they all collectively hold the humerus onto the scapula. Of these, supraspinatus also has the important function of preventing any inferior dislocation of the humeral head.

- **Supraspinatus**
 - Abductor
- **Infraspinatus**
 - Lateral rotator
- **Teres minor**
 - Lateral rotator
- **Subscapularis**
 - Medial rotator

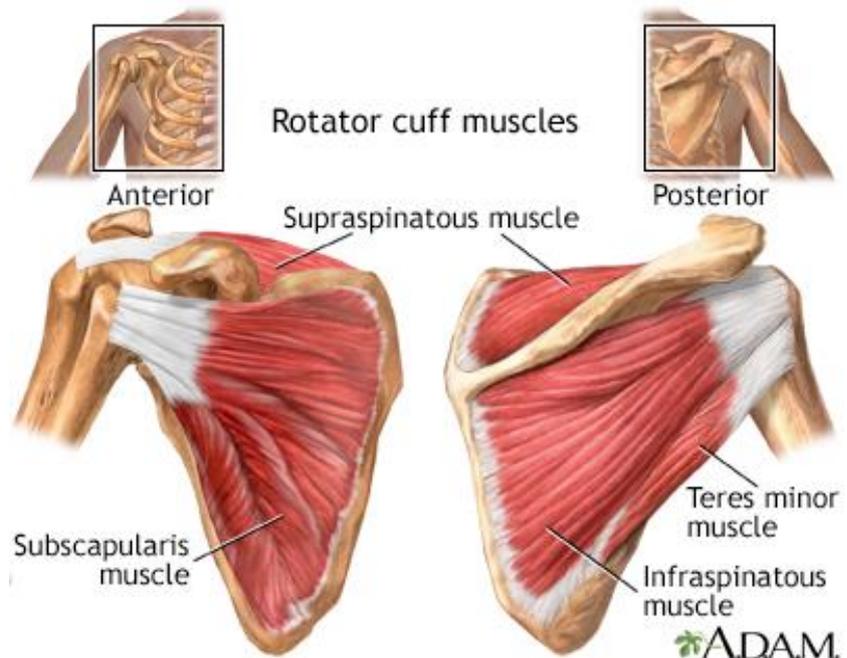


Figure 11 - Rotator Cuff muscles

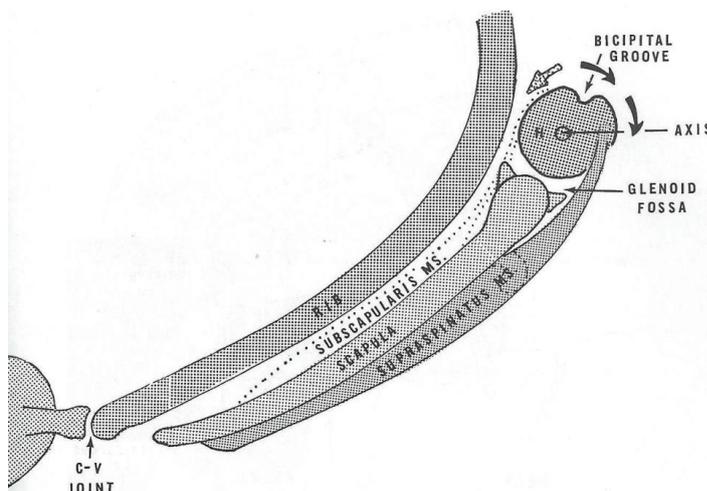


Figure 12 Rotator cuff actions on scapula

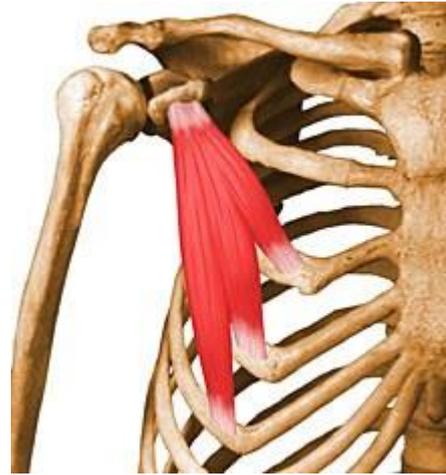
Viewed from above, the subscapularis is situated between the scapula and the rib cage. It is an internal rotator. Supraspinatus and the external rotators are situated on the external surface of the scapula. C-V is the costovertebral joint.

Muscles from the trunk to the scapula

This group of muscles have the function of moving the scapula in relation to the thoracic cage. They are:

- **Pectoralis minor** - depresses shoulder
- **Serratus anterior** - protracts scapula
- **Levator scapulae** - elevates scapula
- **Rhomboids** - retracts scapula
- **Trapezius** - elevate, depress, retracts, medially rotates scapula

Figure 13 Pectoralis minor



Serratus Anterior

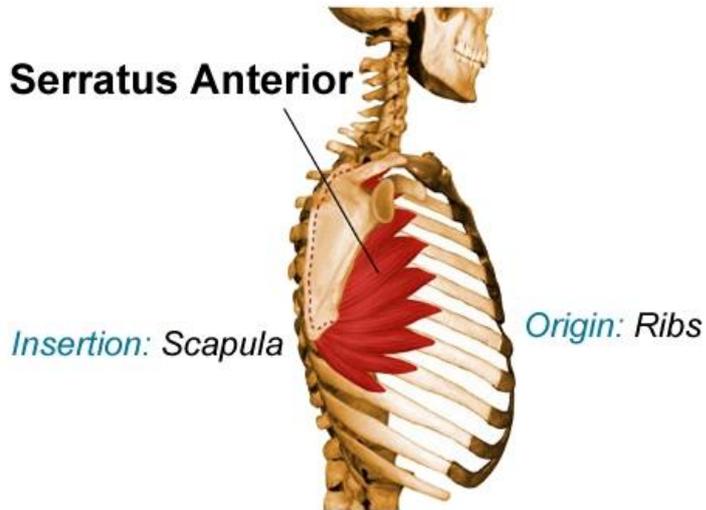


Figure 14 Serratus Anterior

Serratus anterior is one of those three dimensional structured muscles that is particularly difficult to visualise. Only seeing it from several angles can its structure and function be appreciated

Figure 15 Serratus Anterior, seen from above

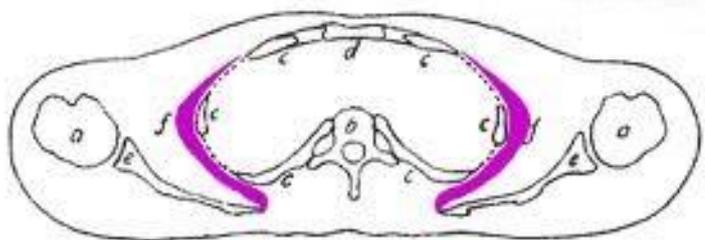


Figure 16 Serratus anterior, in relation to Subscapularis

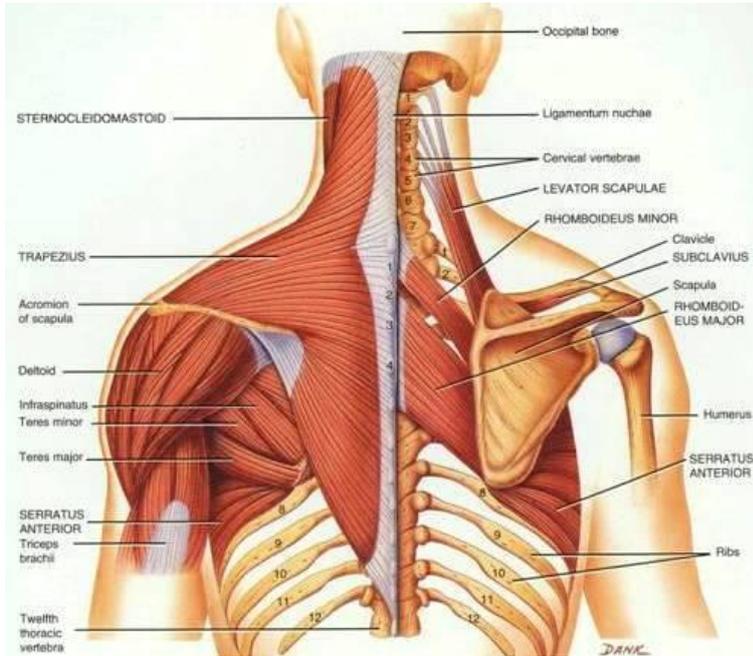


Figure 17 Periscapular muscles: rhomboids, levator scapulae, and trapezius

As was said, the periscapular muscles move the scapula in relation to the thoracic cage (i.e. the trunk).

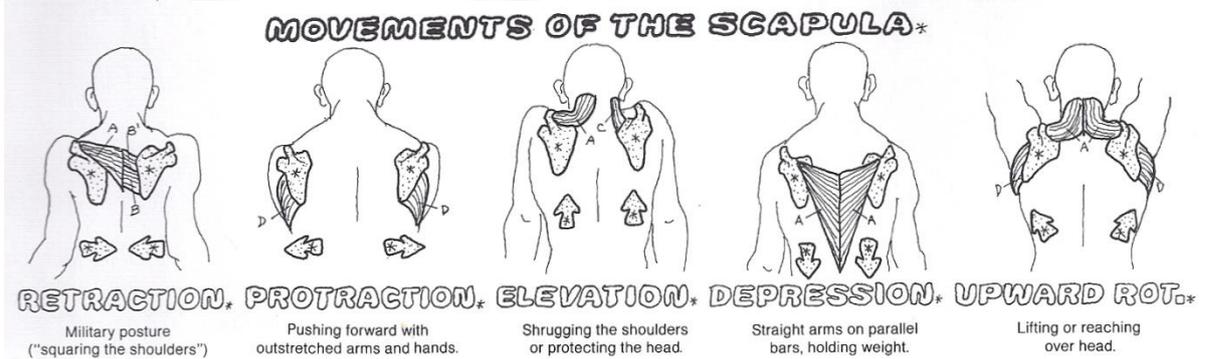


Figure 18 Movements of the scapula

Muscles from the scapula to the arm

These muscles move the humerus in relation to the scapula. They are:

- **Coracobrachialis** Flexes glenohumeral joint
- **Teres major** Extends, adducts and medially rotates
- **Biceps brachii** Not officially classified as a shoulder muscle
- **Triceps Brachii** Not officially classified as a shoulder muscle

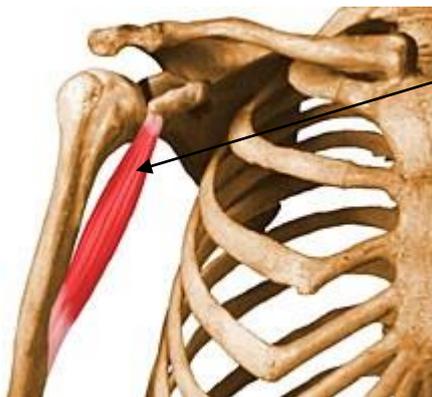
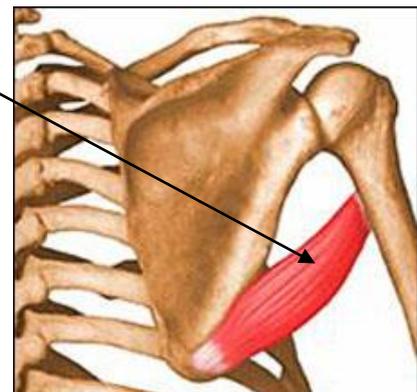


Figure 19 Coracobrachialis

Figure 20 Teres Major

Teres major arises from the lateral border of the scapula, comes up and forward, through to the front of the arm



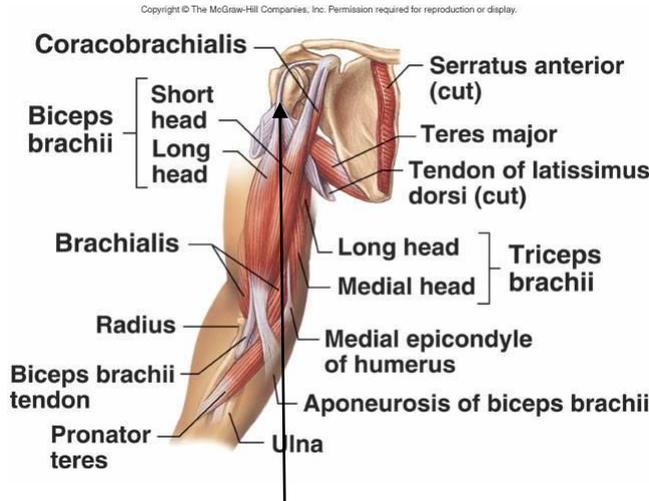
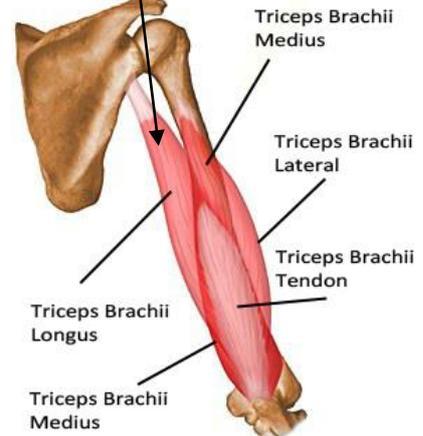


Figure 22 Biceps brachii

Biceps and triceps are only ever defined of muscles moving the elbow. However, they both have heads originating from above the glenohumeral itself.

- **Biceps long head** has an origin from the supraglenoid tubercle
- **Triceps long head** has an origin from the infraglenoid tubercle

Figure 21 Triceps

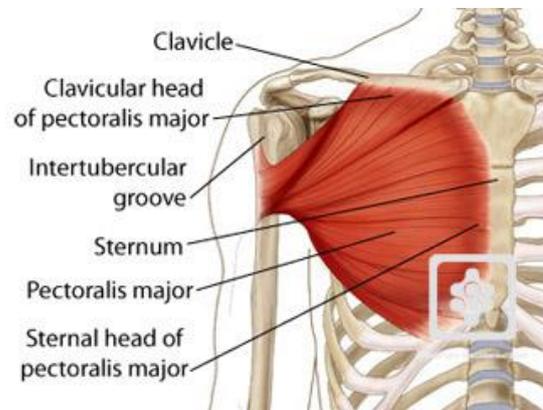


Long muscles of the shoulder

These muscles tend to be bigger, more powerful and cover over the other shoulder muscles

- **Pectoralis major**
- **Deltoid**
- **Latissimus dorsi**

Figure 23 Pectoralis Major

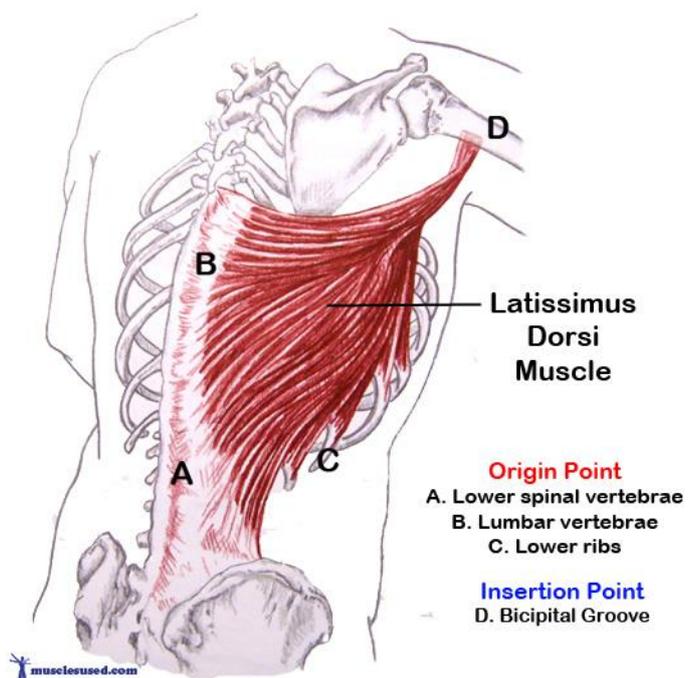


Pectoralis major originates from the medial end of the clavicle and the sternum and costal cartilages of the top six or seventh ribs and inserts into the bicipital groove.

Its actions are only across the glenohumeral joint: flexion, adduction and medially rotates.

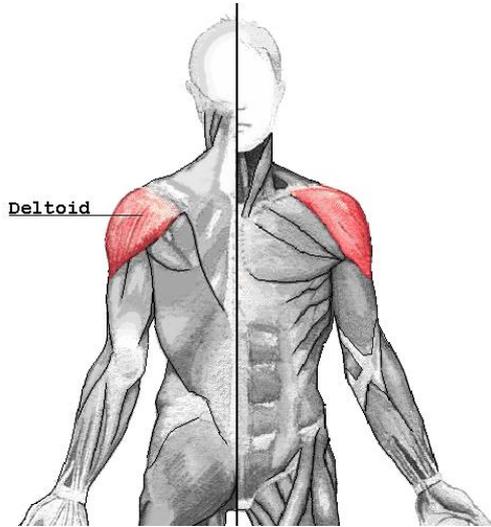
Figure 24 Latissimus Dorsi

Latissimus dorsi has a very broad region of origin including the iliac crest, and the spinous processes of T7 to L5, including the Thoracolumbar fascia and the iliac crest. The muscle originates as a flat sheet, with these fibres converging, wrapping around the course of teres major before forming part of the posterior



axilla and inserting above teres major on the anterior humerus. It also has relationships with serratus posterior inferior, the inferior angle of the scapula and the ribs 7-9 as well the long head of triceps.

Like teres major, latissimus dorsi passes from the posterior trunk through to the anterior of the arm. It has the same actions as teres major: adduction, extension and medial rotation of the humerus. It also fixes the arm against the body whilst lifting.



Deltoid has three sections: anterior (from the lateral clavicle), lateral (from the acromion) and posterior (from the spine of the scapula). All three heads converge on the deltoid tuberosity. Its heads can flex, abduct, and extend the humerus

Figure 25 Deltoid

Hence, looking at these anatomical groups

Muscle Group	Name	Actions
Rotator cuff muscles: All act on glenohumeral joint	Supraspinatus	Abducts glenohumeral
	Infraspinatus	Lateral rotation
	Teres minor	Lateral rotation
	Subscapularis	Medial rotation
From Scapula to Trunk All move scapula on trunk	Levator scapulae	Elevates scapula and rotates it laterally
	Rhomboids (major and minor)	Retracts and elevates scapula
	Pectoralis minor	Depresses scapula Elevates ribs 3-5
	Serratus anterior	Protracts scapula
	Trapezius	Elevates, retracts, depresses, medially rotates
From scapula to humerus All move glenohumeral joint	Coracobrachialis	Flexes
	Teres major	Adducts, extends, medially rotates
	Biceps - Short and long head	Flexes
	Triceps	Extends
Long muscles All act on glenohumeral	Pectoralis major	Flexes and adducts
	Latissimus dorsi	Adducts, extends, medially rotates
	Deltoid	Abducts, flexes extends

These same muscles can be rearranged to express themselves functionally

Flexors	Extensors
Coracobrachialis	Deltoid, posterior
Deltoid, anterior	Teres major
Biceps, short and long heads	Latissimus dorsi
	Triceps
Abduction	Adduction
Supraspinatus	Teres major
Deltoid	Latissimus dorsi
	Pectoralis major
Medial rotation	Lateral rotation
Subscapularis	Infraspinatus
Teres major	Teres minor
Latissimus dorsi	
Protractors	Retractors
Serratus anterior	Trapezius (medial fibres)
Pectoralis major	Rhomboids
Elevators	Depressors
Trapezius (upper fibres)	Trapezius (lower fibres)
Levator scapulae	Pectoralis major (lower fibres)
Rhomboids	Latissimus dorsi

Nerve root names values to shoulder and arm

Nerves					
<i>Dorsal scapular</i> Rhomboids	C5				
<i>Axillary</i> Teres minor Deltoid	C5	C6			
<i>Musculocutaneous</i> Coracobrachialis, Biceps, Brachialis	C5	C6			
<i>Subscapular</i> Subscapularis, teres major	C5	C6			
<i>Suprascapular</i> Supraspinatus, Infraspinatus	C5	C6	C7		
<i>Long thoracic</i> Serratus anterior	C5	C6	C7		
<i>Lateral pectoral</i> Pectoralis major	C5	C6	C7		
<i>Thoracodorsal</i> Latissimus dorsi	C5	C6	C7	C8	
<i>Medial pectoral</i> Pectoralis major/minor				C8	T1
<i>Median</i> Wrist and fingers - flexors	C5	C6	C7	C8	T1
<i>Radial</i> Triceps; wrist/fingers extensors	C5	C6	C7	C8	T1

Muscle names and their Named Nerves and root values

Muscles	Nerve Name	Root Value							
		C2	C3	C4	C5				
Trapezius	Spinal Accessory	C2	C3	C4	C5				
Levator scapulae	Dorsal Scapular		C3	C4	C5				
Rhomboids	Dorsal Scapular			C4	C5				
Supraspinatus	Suprascapular			C4	C5				
Infraspinatus	Suprascapular				C5	C6			
Teres minor	Axillary				C5	C6			
Subscapularis	Subscapular				C5	C6			
Deltoid	Axillary				C5	C6			
Coracobrachialis	Musculocutaneous				C5	C6			
Biceps	Musculocutaneous				C5	C6			
Brachialis	Musculocutaneous				C5	C6			
Brachioradialis	Radial				C5	C6			
Serratus anterior	Long thoracic				C5	C6	C7		
Teres major	Lower subscapular Thoracodorsal				C5	C6	C7		
Triceps	Radial					C6	C7		
Pectoralis Major	Medial pectoral Lateral pectoral				C5	C6	C7	C8	T1
Pectoralis Minor	Medial pectoral					C6	C7	C8	T1

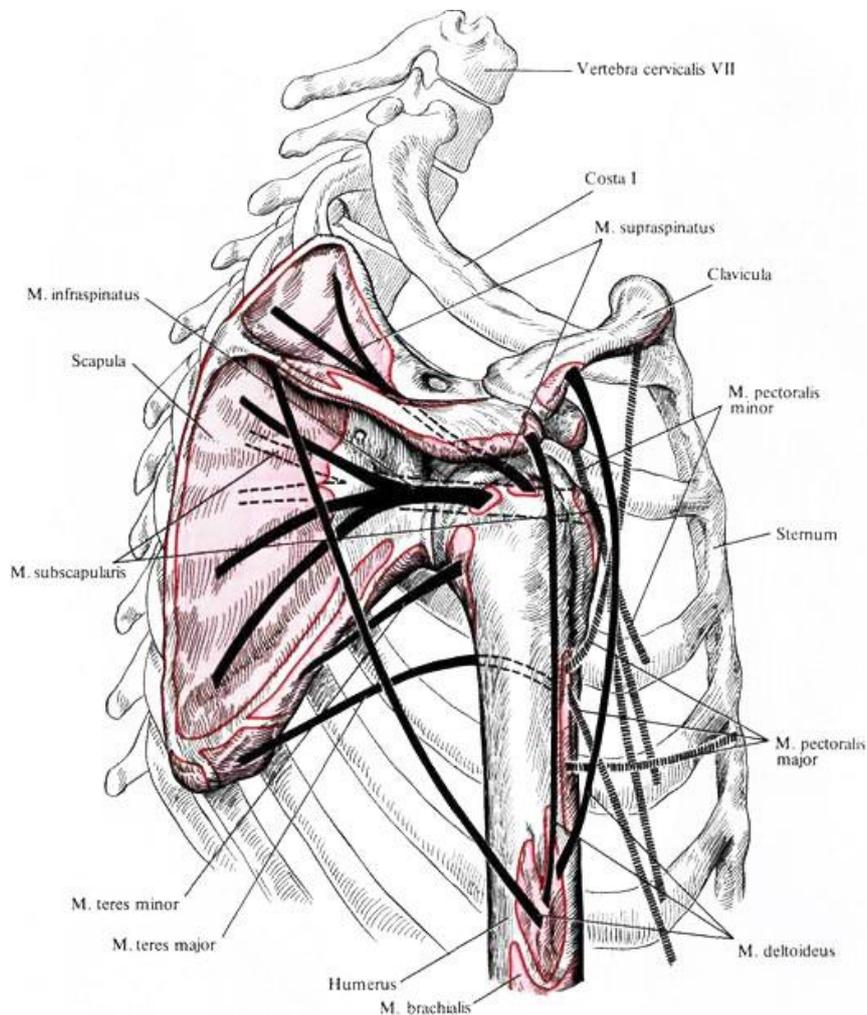


Figure 26 Schematic of shoulder muscles showing directions of pull

The Axilla

The axilla is the name given to an area that lies underneath the glenohumeral joint, at the junction of the upper limb and the thorax.

This region is a passage by which structures such as vessels and nerves can enter and leave the upper limb.

Borders

The overall 3D shape of the axilla looks slightly like a **pyramid**. The borders consist of four sides and a base with an opening at the apex.

- **Apex** – Also known as the axillary inlet, this is formed by lateral border of the first rib, superior border of scapula, and the posterior border of the clavicle.
- **Lateral wall** – Formed by intertubercular groove of the humerus.
- **Medial wall** – Consists of the serratus anterior and the thoracic wall (ribs and intercostal muscles).
- **Anterior wall** – Contains the pectoralis major and the underlying pectoralis minor and the subclavius muscles.
- **Posterior wall** – Formed by the subscapularis, teres major and latissimus dorsi, though some include the long head of triceps as well

The size and shape of the axilla region **varies** with arm abduction. It decreases in size most markedly when the arm is fully abducted – at this point, the contents of the axilla are at most risk of injury

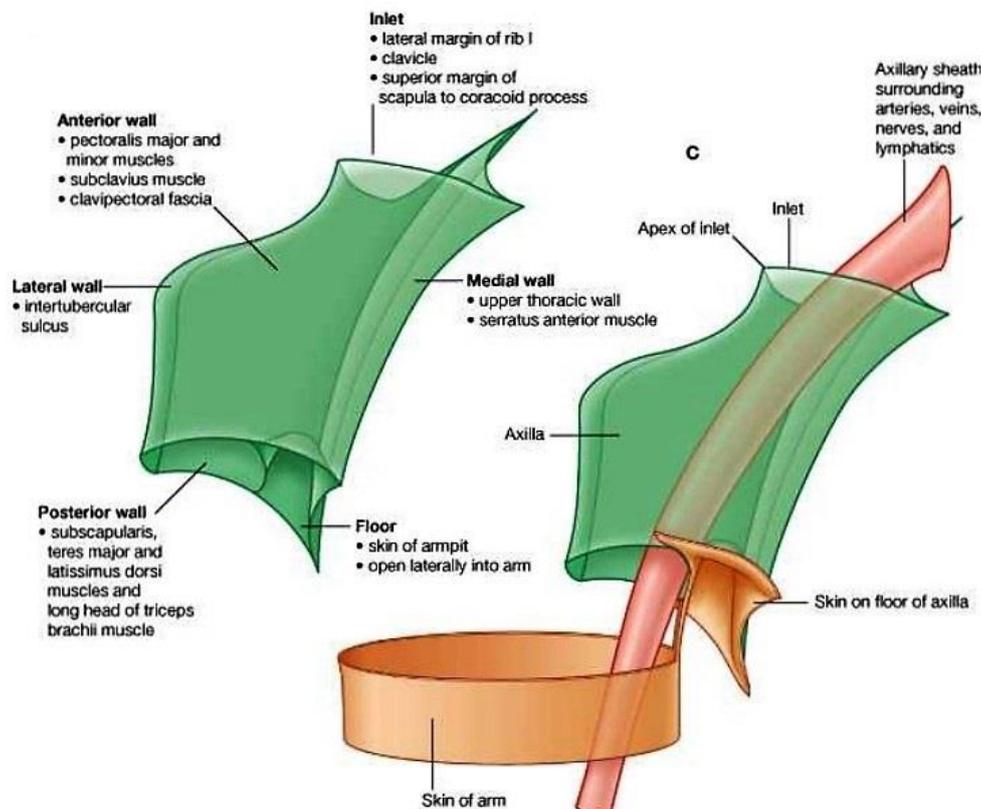


Figure 27 Diagram demonstrating the borders of the axilla

The size and shape of the axilla region **varies** with arm abduction. It decreases in size most markedly when the arm is fully abducted – at this point, the contents of the axilla are at most risk of injury

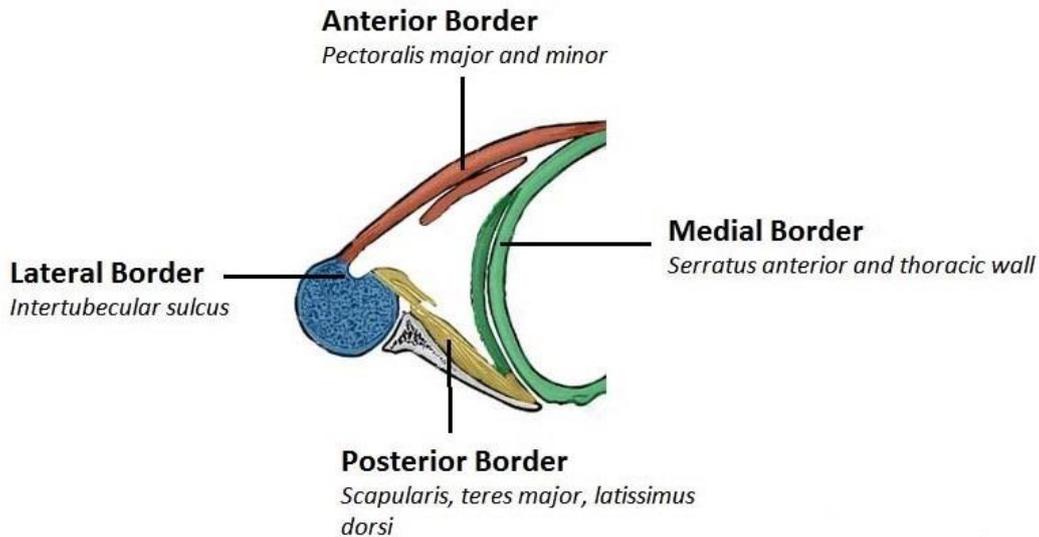


Figure 28 the axilla - seen from above

Contents of the axilla

The main, and clinically important contents of the axilla region include muscles, nerves, vasculature and lymphatics:

- **Axillary artery** – It is the main artery supplying the upper limb. It is commonly referred as having three parts, one medial to the pectoralis minor, one posterior to pectoralis minor, and one lateral to pectoralis minor. The medial and posterior parts travel in the axilla.
- **Axillary vein** – The main vein draining the upper limb, its two largest tributaries are the cephalic and basilic veins.
- **Brachial plexus** – A collection of spinal nerves that form the peripheral nerves of the upper limb.
- **Biceps brachii and coracobrachialis** – These muscle tendons move through the axilla, where they attach to the coracoid process of the scapula.
- **Axillary Lymph nodes** – The axillary lymph nodes filter lymph that has drained from the upper limb and pectoral region. In women, axillary lymph node enlargement is a non-specific indicator of breast cancer.

Brachial Plexus

The brachial plexus is a **network** of nerve fibres that supplies the skin and musculature of the upper limb. It begins in the root of the neck, passes through the axilla, and enters the upper arm.

The plexus is formed by the **anterior rami** (divisions) of the cervical spinal nerves C5, C6, C7 and C8, and the first thoracic spinal nerve, T1.

The brachial plexus is divided into five parts; roots, trunks, divisions, cords and branches (a good mnemonic for this is **Read That Damn Cadaver Book**). There are no functional differences between these divisions – they are simply used to aid explanation of the brachial plexus.

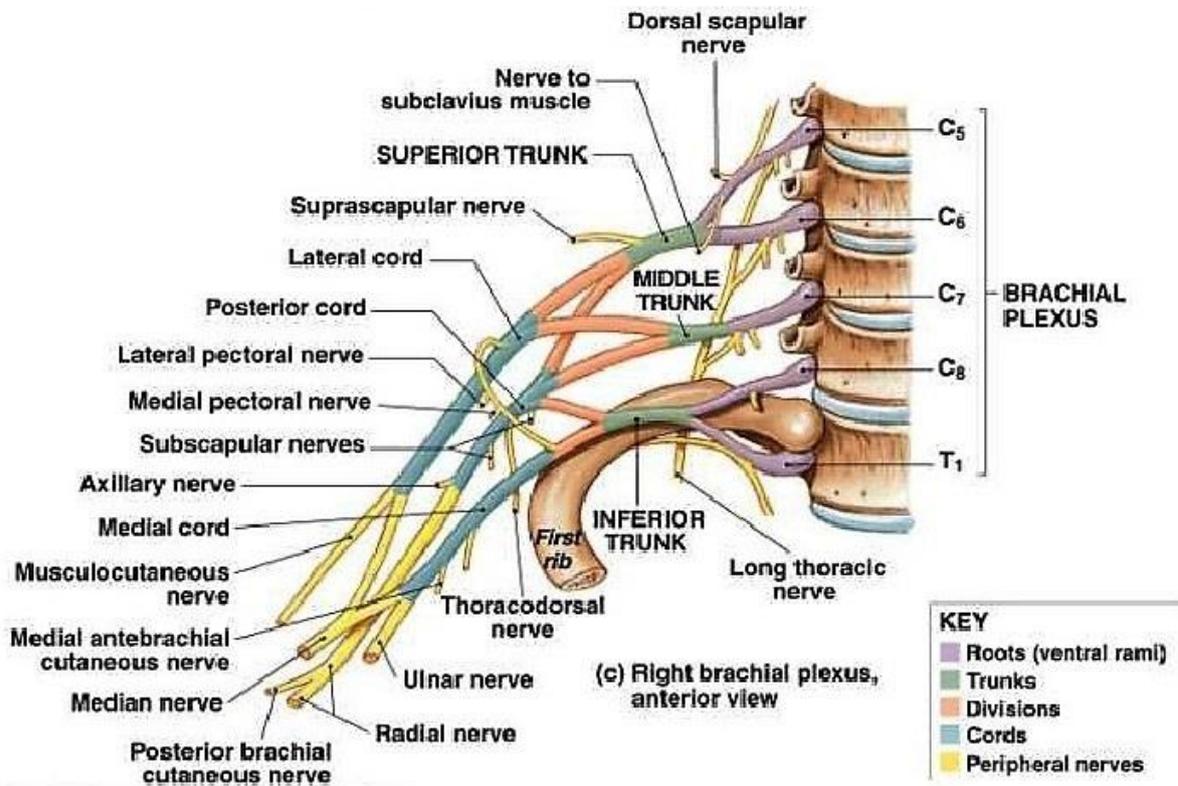


Figure 29 Brachial Plexus - showing Roots, Trunks, Divisions, Cords, and Branches

The brachial plexus can be analysed at length but there is a sequence. There are nerve roots. These come together and separate, then come together again and separate. The branches (end nerves) are at the end of all this. The trunks are named in relation to each other (upper, middle and lower) and the cords are named in relation to the adjacent Axillary artery (medial, lateral and posterior).

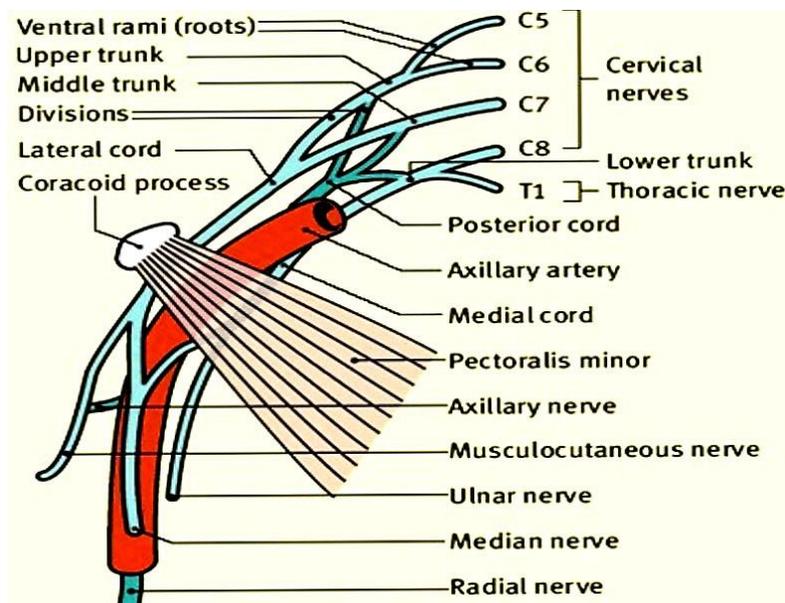


Figure 30 Brachial plexus showing the cords in relation to the axillary artery

Location of parts of the brachial plexus

- **Roots** – emerge between (anterior and middle) scalene muscles of cervical spine
- **Trunks** - posterior triangle of the neck
- **Divisions** - behind the clavicle
- **Cords** - in the Axilla

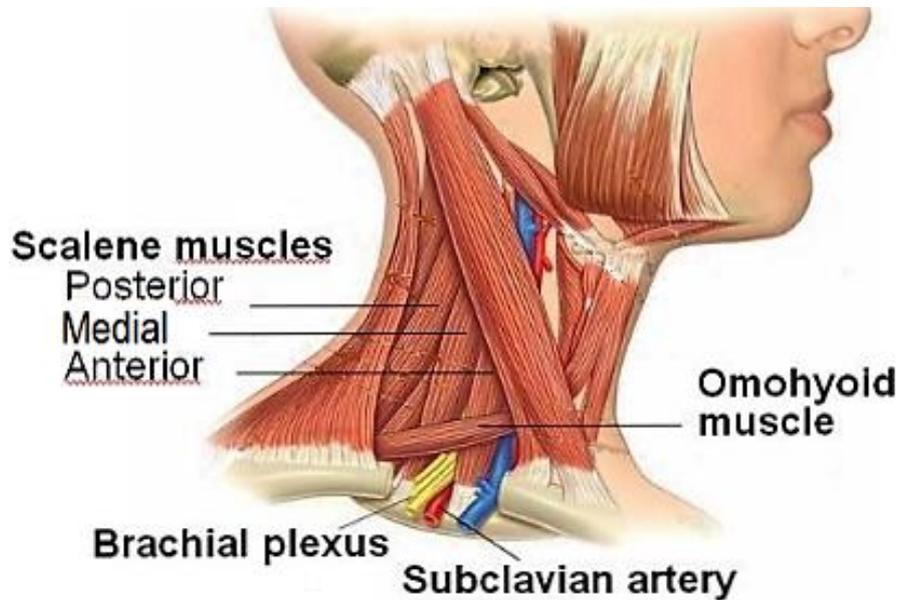


Figure 31 Diagram showing scalenes on side of cervical spine, with emerging roots of brachial plexus

Seeing the brachial plexus from another anatomical point of view

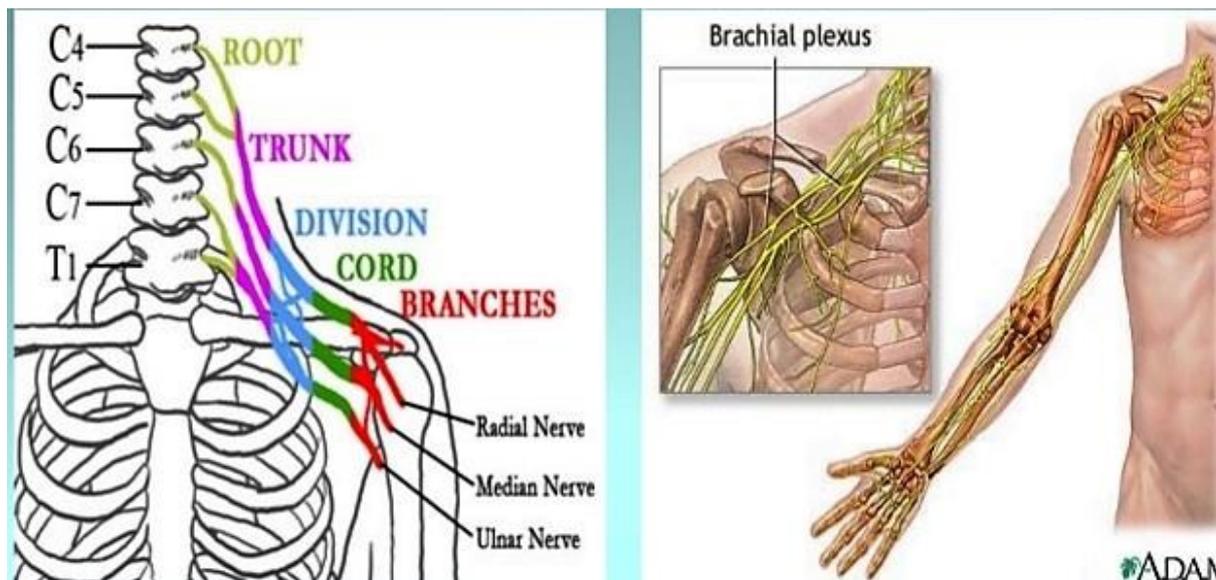


Figure 32 Brachial Plexus in relation to local bony anatomy

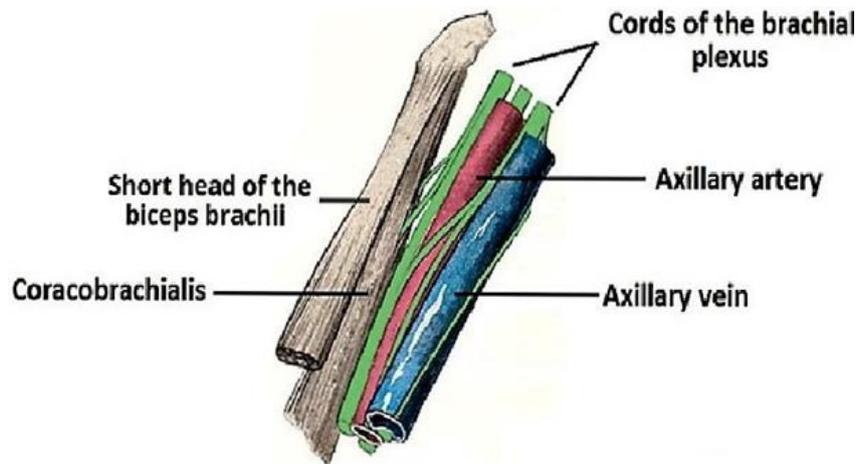


Figure 33 Diagram showing cords of brachial plexus in relation to axillary artery, as it enters the arm

Passageways Exiting the Axilla

There are three main routes by which structures leave the axilla into the upper arm. The main route of exit is immediately inferiorly and laterally, into the **upper limb**. Most of the contents of the axilla region leave by this method.

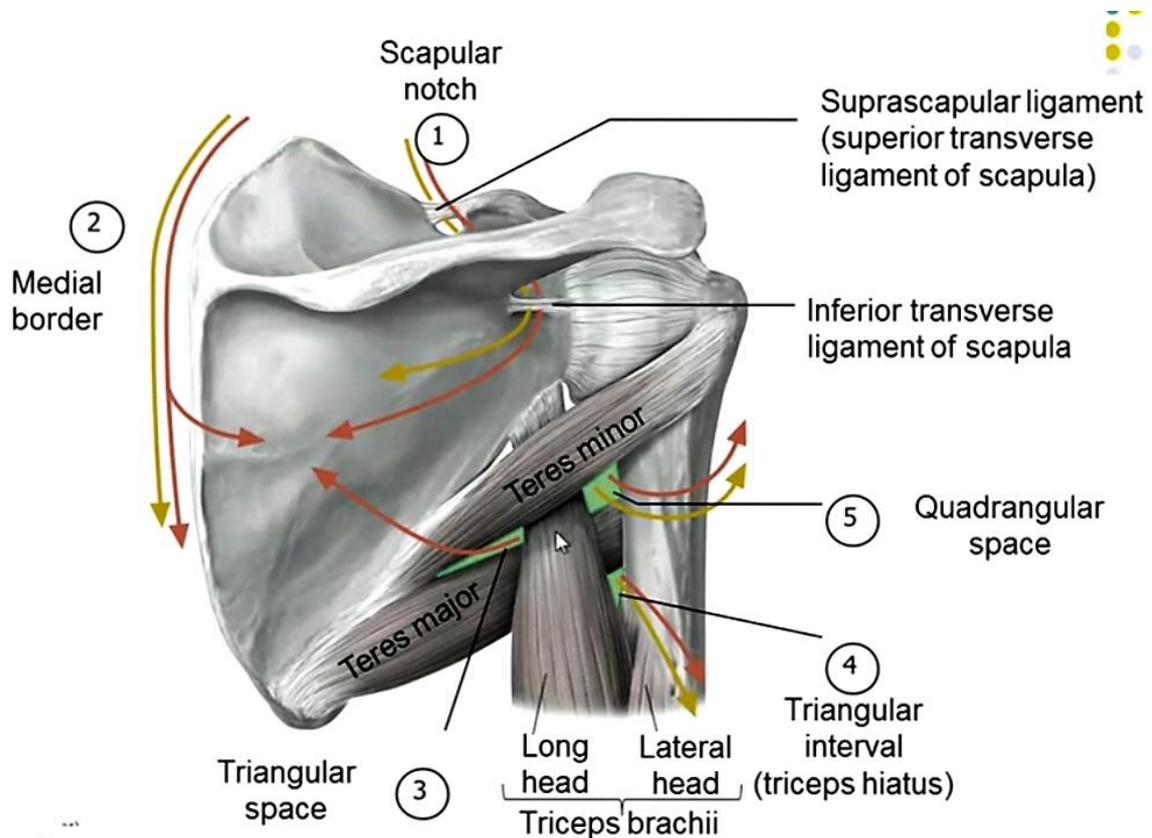


Figure 34 Diagram of posterior axilla, seen from behind, showing spaces for emerging structures

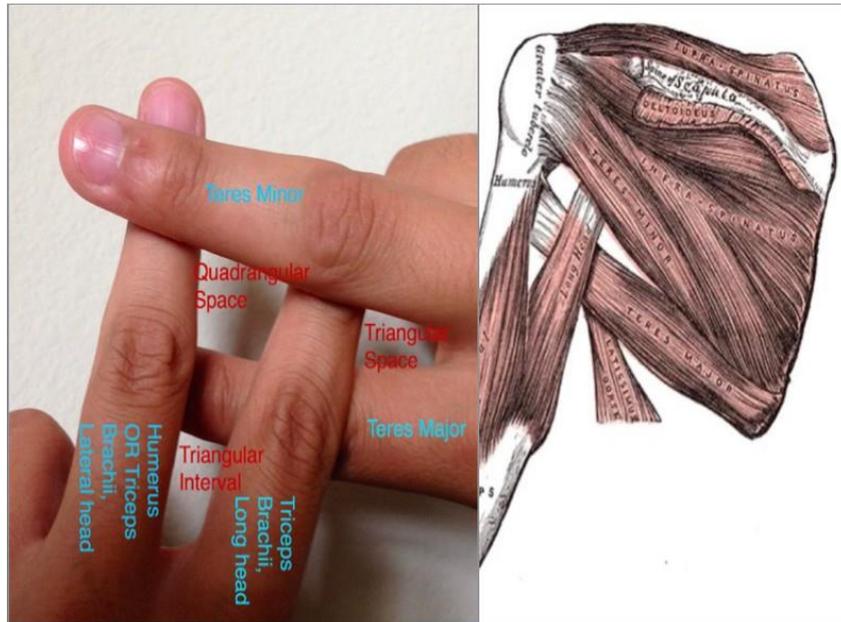


Figure 35 Schematic, using fingers, demonstrating posterior spaces of axilla

One pathway is via the **quadrangular space**. This is a gap in the posterior wall of the axilla, allowing access to the posterior arm and shoulder area. Structures passing through include the **axillary nerve** and **posterior circumflex humeral artery** (a branch of the axillary artery).

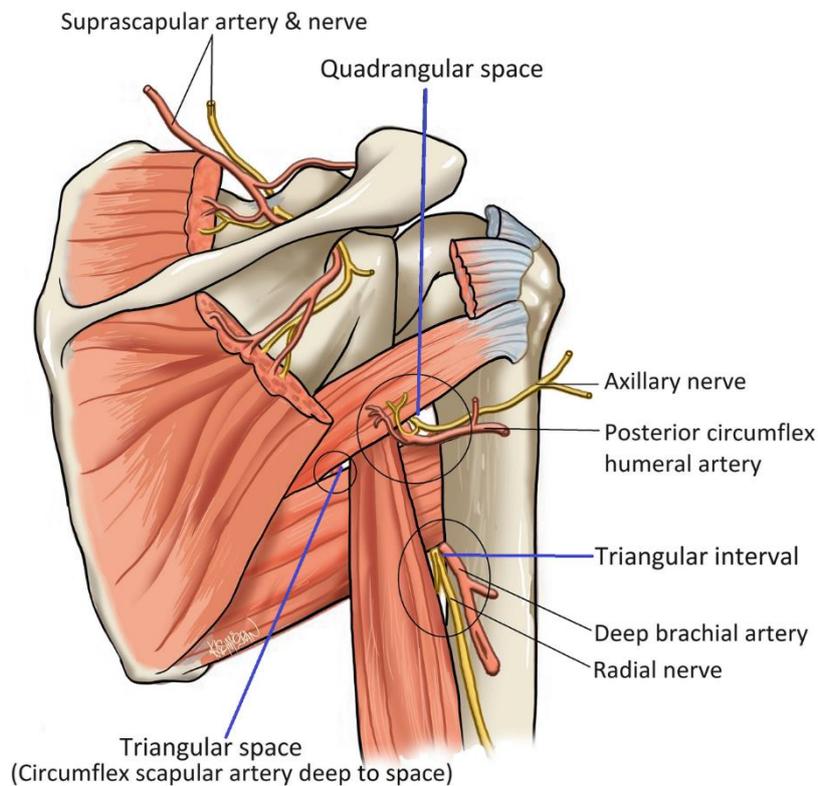


Figure 36 Posterolateral view of shoulder showing quadrangular space

Another space of exit is the **triangular space** (as opposed to the triangular interval)

Triangular space - circumflex scapular artery

Triangular interval - radial nerve

Movements of the shoulder

Abduction

The full range of abduction of the arm is 180° , however if the scapula was fixed firmly to the side of the body, abduction of the arm would be held in internal rotation and limited to 60° before the greater tuberosity became compressed against the underside of the acromion.

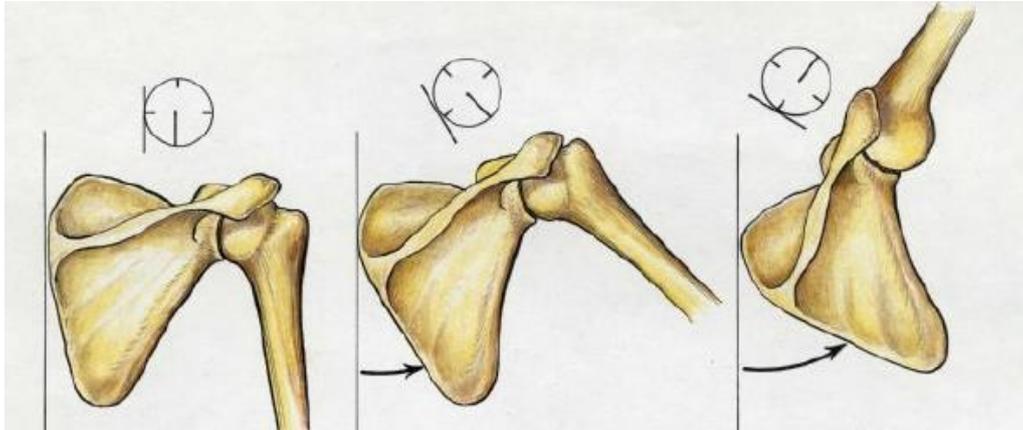


Figure 37 Abduction of the arm

To achieve normal shoulder motion, the acromioclavicular joint must be able of coordinating the unique three-dimensional motion planes of both the scapula and the clavicle. Shoulder elevation requires long-axis rotation (up to 50°), elevation (up to 15°), and posterior angulation (i.e., retraction; up to 30°) of the clavicle relative to its resting position; however, the acromioclavicular joint itself may only be responsible for a portion of this motion where sternoclavicular joint motion makes up the majority of this difference. More specifically, approximately 31° of posterior longitudinal rotation of the clavicle occurred at the sternoclavicular joint whereas about 19° of posterior scapular tilt was allowed across the acromioclavicular joint. Disruption of the acromioclavicular joint following an acute injury can therefore result in uncoordinated scapular motion and global shoulder dysfunction.

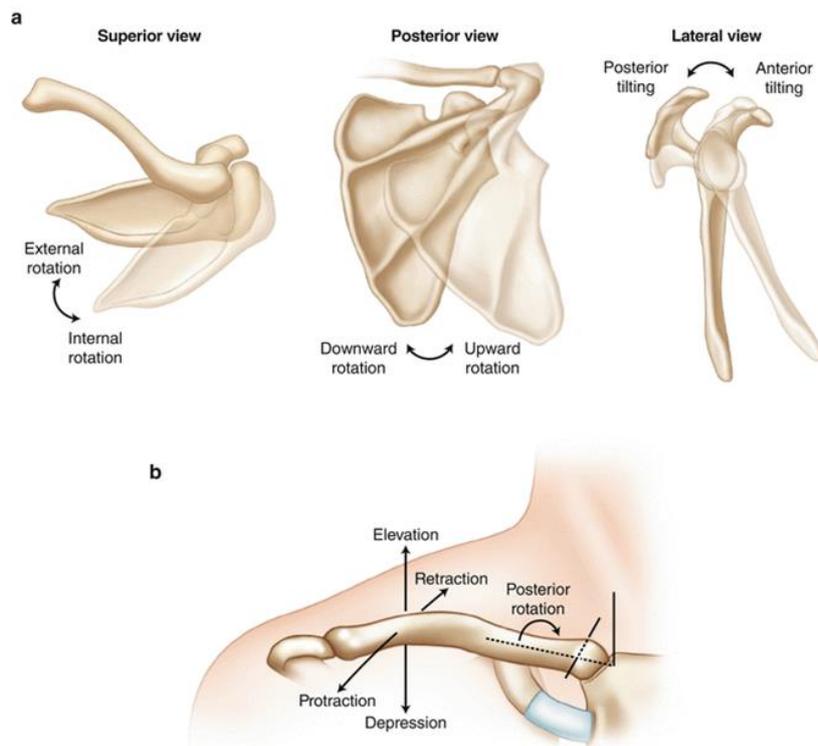


Figure 38 Positions of the scapula with abduction

The clavicle allows for abduction of the shoulder because of its 'S' shape. The clavicle rotates 50° when the shoulder is fully abducted. Loss of motion in the clavicle at either the acromioclavicular or sternoclavicular joints affects abduction of the arm. 60% of the clavicular movement occurs at the distal end.

External rotation of the humerus allows for 120° abduction because the humerus is out of the way. In addition to this, the scapula needs to rotate medially, hence some of the periscapular muscles need to be able to rotate the scapula and other periscapular muscles need to be compliant enough to permit this movement to occur.

The scapular movement accounts for the remainder of the of 180° abduction. The scapula follows the curvature of the outside of the ribs. The ratio of glenohumeral movement to scapulothoracic movement is 2:1. While this is the 'standard' glenohumeral/scapulothoracic movement is not always consistent and the ratio may be as high as 12:1, depending upon the position of the shoulder, elbow and wrist. The two schematic diagrams below demonstrate the muscles involved in abduction.

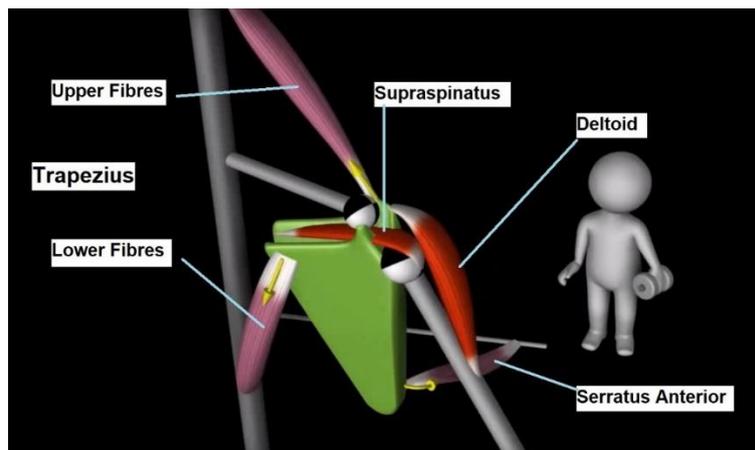


Figure 39 Muscles of shoulder before abduction

Supraspinatus initiates abduction but maintains as isometric contraction throughout the movement to prevent inferior dislocation of the humeral head.

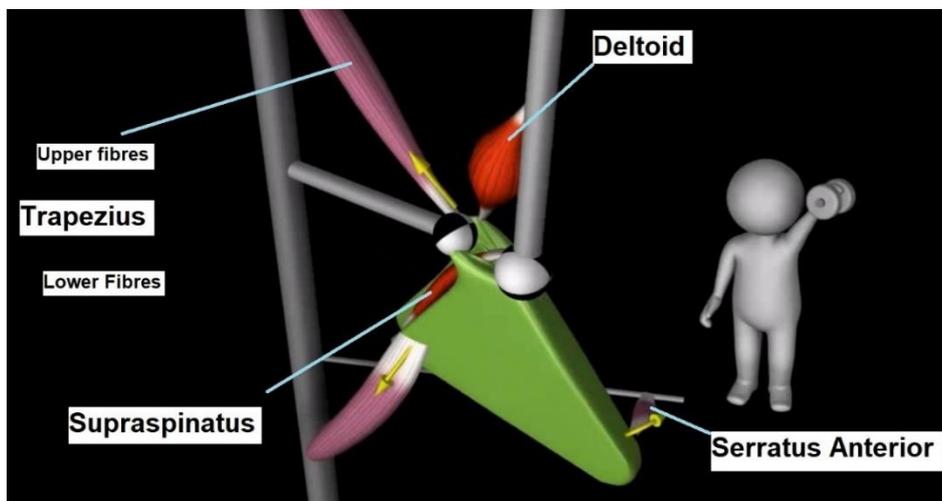


Figure 40 Shoulder in abduction - muscles moving scapula

Deltoid is the primary abductor of the shoulder to 90° and, during this activity, the lower fibres of serratus anterior along with the upper and lower fibres of trapezius rotate and support the scapula. To allow full abduction the humerus must rotate laterally to prevent position of the greater tuberosity with the acromion, positioning it behind the acromion; this coming from the rotator cuff muscles.

The long head of the biceps brachii generally plays a passive role in abduction, but passively depresses the head of the humerus in the glenoid fossa during active abduction and flexion of the arm. Due to its attachment to the scapula (or shoulder blade), biceps also assists with stabilization of the shoulder joint when a heavy weight is carried in the arm. When there is a faulty motion of the glenohumeral joint, the biceps tendon can become inflamed and be a source of pain.

Flexion - it could be said that flexion is not a pure motion within itself but combines with external rotation as well. Here the anterior deltoid and coracobrachialis would be the primary movers, but with the lateral rotators playing a significant role as synergist and the long head of biceps playing a similar role as in abduction.

Normal ranges of movement

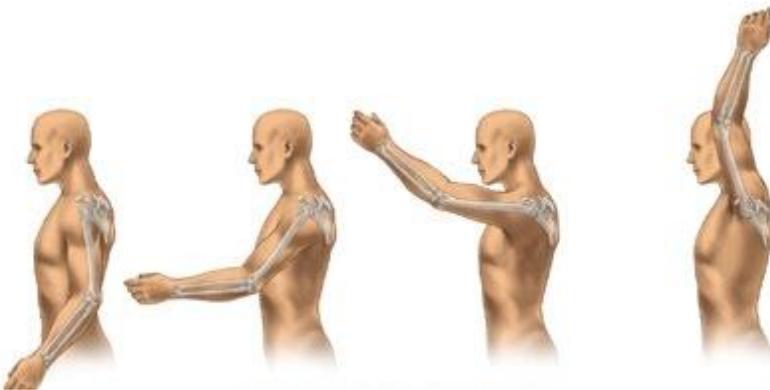


Figure 41 Shoulder Flexion



Figure 42 Shoulder Extension

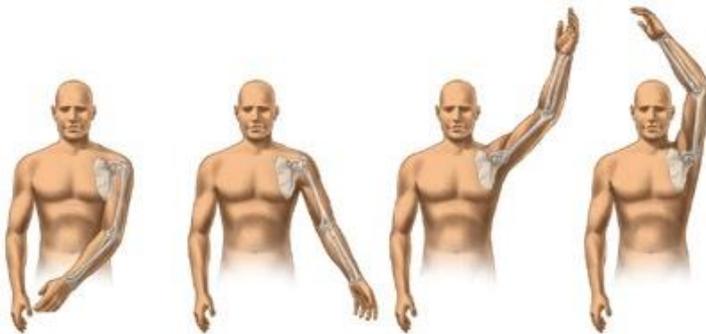


Figure 43 Shoulder Abduction

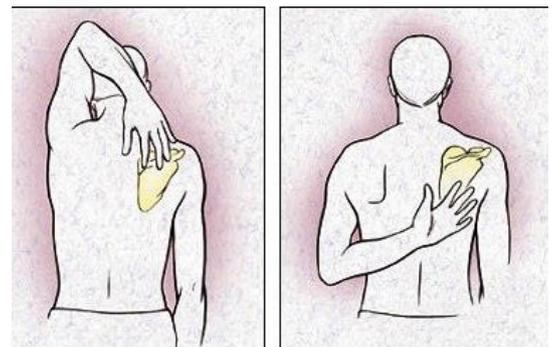


Figure 44 Shoulder External and Internal Rotation

Ranges of movement

- Flexion - 180°, of which 90° is glenohumeral
- Extension - 45°
- Abduction - 180° of which at least 60° is glenohumeral
- Adduction - 45°
- External - rotation - 75° (hand down back)
- Internal rotation - 55° (hand up back)

Dysfunctions of the Shoulder

- **Dislocation**
- **Rotators cuff tears**
- **Adhesive capsulitis**
- **Bursitis**
- **Chronic muscle tension/myofascial tension**

Dysfunctions and pain of the shoulder can occur with inappropriate neuromuscular function, expressive activity leading to repetitive traumata, local external trauma or as part of a referral pain pattern from viscera.

Dislocations

A dislocation is when any joint is taken outside its normal joint alignment. This is primarily a structure challenge, so a review of the structures around the shoulder is called for:

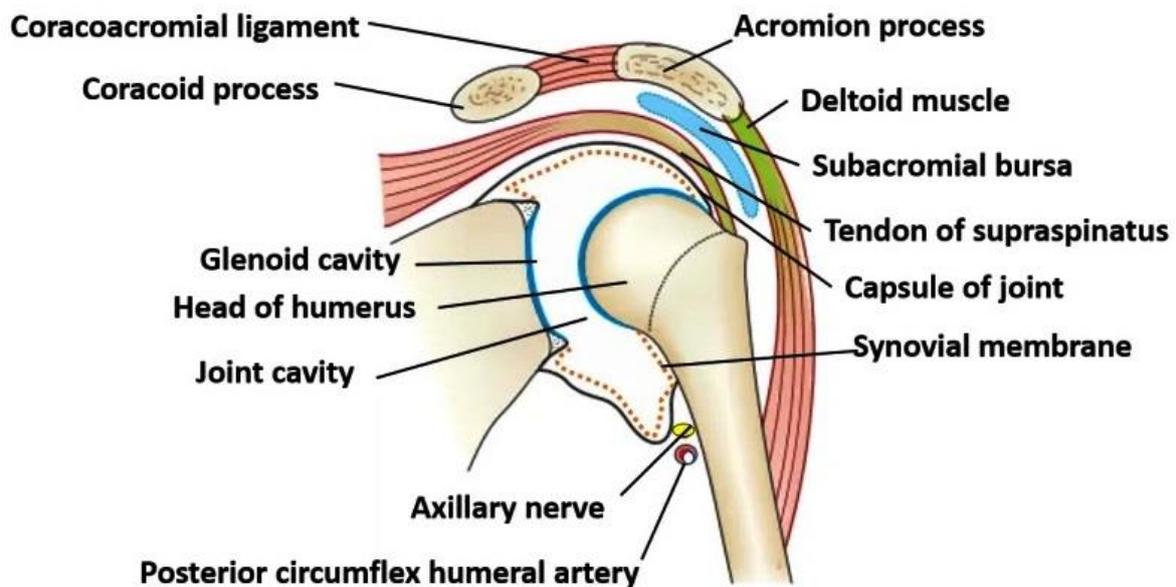


Figure 45 Glenohumeral tissue relationships

The glenohumeral region has numerous tissues, many of which are nociceptive and are contained within a relatively small space. Because of the amount of motion here, lubrication is mandatory and is afforded by the subdeltoid (subacromial) bursa and the capsule, both with their synovial membranes.

With reference to sport, specific sports create demands upon the shoulder complex, and these vary from sport to sport. Some examples of varying sport demands on the shoulder include:

- Defensively - breaking the fall of a body or stopping an object or person
- Catching an object - baseball, basketball
- Propelling an object - a ball, serving in tennis, javelin, bowling in cricket
- Combat - boxing, stick chase in lacrosse, hockey
- Fine motor skills, pool, darts, archery

Acute trauma - direct

1. Contusion
2. Dislocation/subluxation
3. Fracture

Generally, males are more prone to dislocations than females. Females have a greater range of movement and flexibility, which aids in their avoidance of dislocations and subluxations. Glenohumeral anterior and inferior dislocations are more like to occur than posterior ones. Current thoughts are centred on the fact that males play more violent sport, while females are involved in less ballistic types of activity. However, females do have a higher rate of multi-directional instability than do males.

Acute trauma - indirect

1. Rotator cuff tears
2. G/H dislocations
3. G/H subluxations (e.g. Bankart lesion, Hill Sachs lesion, dead arm syndrome)
4. A/C separations
5. S/C separations
6. Trigger points
7. Labrum tears
8. Frozen shoulder

Over-use syndromes

Micro-traumata that may lead to major trauma

1. Impingement (the greatest compression range of movement is about 80° - 120° abduction)
2. Myositis
3. Tendinitis
4. Bursitis

All the above occur simultaneously and could be considered a single combined condition

The dysfunction pattern of the shoulder is complex and often circular in nature. The circle is ever changing and can go in either direction. The common factors are impingement, instability with the resultant dysfunction of myositis and secondary sequelae of rotator cuff tears. Some clinicians believe that microtraumata is the result of failure in the muscle system. The history of the injury will be vague and upon further examination may reveal trigger points and myofascial dysfunction. Overuse syndromes have an aetiology that is reduced to muscular imbalance, poor mechanics and/or associated pathology from either prior acute or chronic injuries. Microtrauma may lead to macrotrauma. This is a direct correlation to the circular concept of dysfunction. Microtrauma of the cuff may later result in a rotator cuff tear.

Direct trauma

A direct fall on an outstretched arm is a definitive case of external trauma that can result in tissue damage. The resultant injury can affect many or all of the tissues in the shoulder complex. Here a meaningful case history (possibly including X-Rays) is diagnostic. Faulty neuromuscular dysfunction or repetitive minor traumata may be harder to pin-point (people 'need' to see a singular traumatic cause). Faulty neuromuscular activity means that the scapulohumeral rhythm is dysfunctional; the arm abducts and elevates without adequate external rotation.

Diagnostic procedures

The person may point to the site of pain, which can be corroborated by manual palpation (i.e. you can find and/or precipitate the pain). Active and passive movements may precipitate this pain as well.

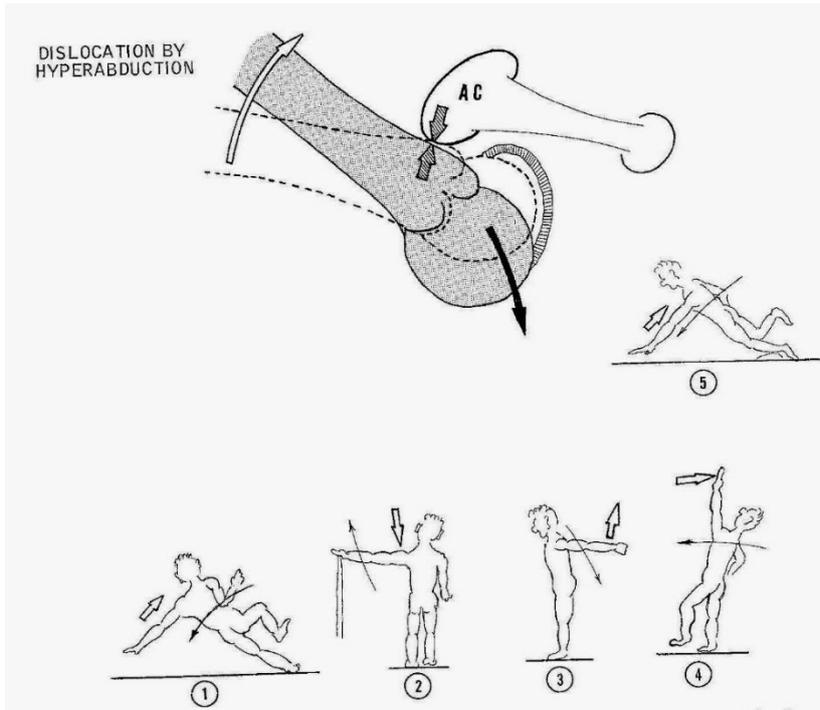


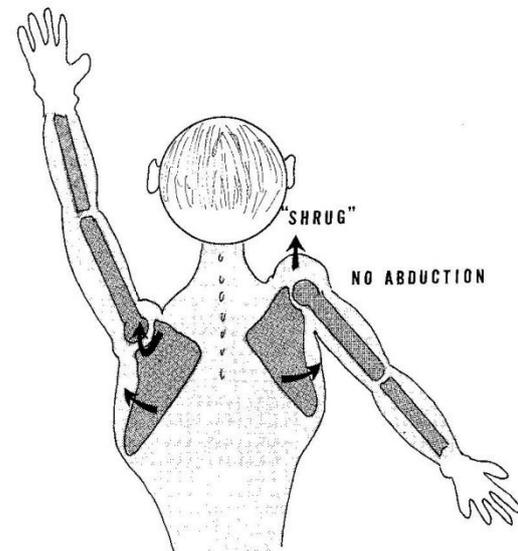
Figure 46 Injuries to Shoulder on Outstretched Arm

Fig 46 Shows examples of injuries to the shoulder on an outstretched arm. Direct injuries to the outstretched arm are shown in 1, 2, 3 and 4. A direct fall, 5, is a common cause of dislocation as shown in the larger drawing. The humerus impinges on the overhanging A/C (two opposing arrows) and dislocates inferiorly (large black arrow).

Tears of the rotator cuff muscles

With injury to the rotator cuff, the glenohumeral activity is impaired. The range of movement is impaired and abduction is limited, such that the scapula follows too early in the normal sequence of movement, sometimes termed as 'shrugging abduction'.

Figure 47 Shrugging Abduction



Rotator cuff injuries are common and can be expressed as tendonitis, a partial tear, or a total tear. The shrugging mechanism may be tendon inflammation, bursitis or even torn fibres.

Shrugging abduction occurs when, because glenohumeral movement is limited, the scapular phase is initiated too early, hence the shrug.

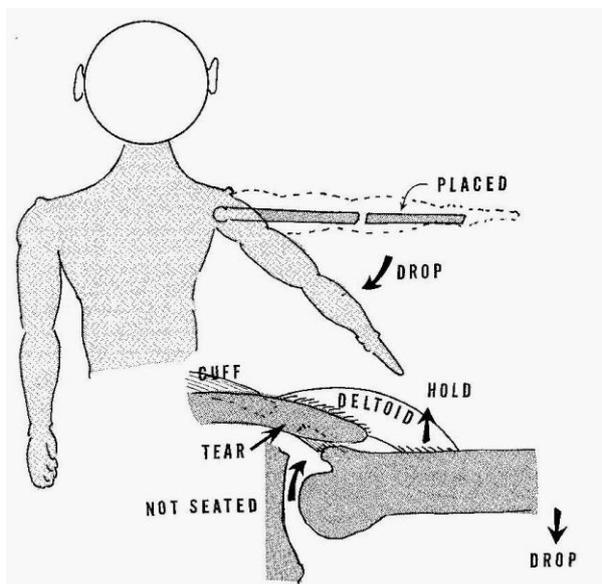


Figure 48 Drop Sign of Rotator Cuff Tear

In a complete tear in the cuff, the deltoid muscle, the deltoid muscle can hold the arm passively abducted, momentarily and weakly. Without the stabilisation of the humeral head in the glenoid fossa by the rotator cuff muscles, the arm eventually drops. This is a clinical sign of a complete cuff tear.

Dislocations of the glenohumeral joint

Dislocation occurs when the humeral head is shifted out of the joint, resulting in a tear or disruption of the periarticular stabilising structures. In the glenohumeral joint, this includes the capsule and rotator cuff muscles (aka fibrotendinous cuff). An unfortunate effect of this knock-on injury is that there is disruption of cartilaginous structures; it predisposes to an ongoing instability of the joint with the possibility of it dislocating again. 80-90% of anterior dislocations are in teenagers, with a high recurrence rate.

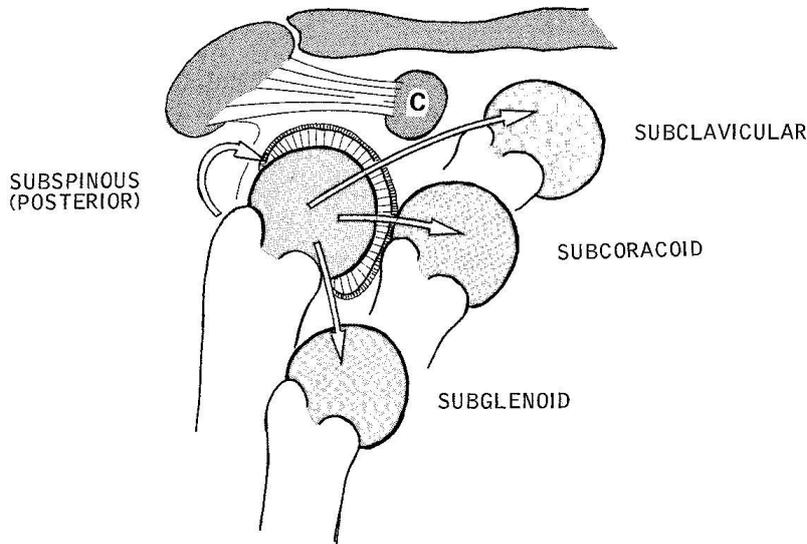


Figure 49 4 Types of Shoulder Dislocation

The subcoracoid dislocation is the most frequent type and the subspinous (posterior) is the least frequent. The diagnostic type is the position of the humeral head in relation to the glenoid fossa at the time of diagnosis.

Subcoracoid

Subcoracoid dislocation is the most frequent type that occurs. It occurs when the head of the humerus is displaced anterior with respect to the glenoid fossa and is inferior to the coracoid process. Here the greater tuberosity of the humerus is fixed on the anterior rim of the glenoid fossa. The neck of the scapula becomes elevated and carried medially, positioning the inferior tip of the scapula in an abducted position.

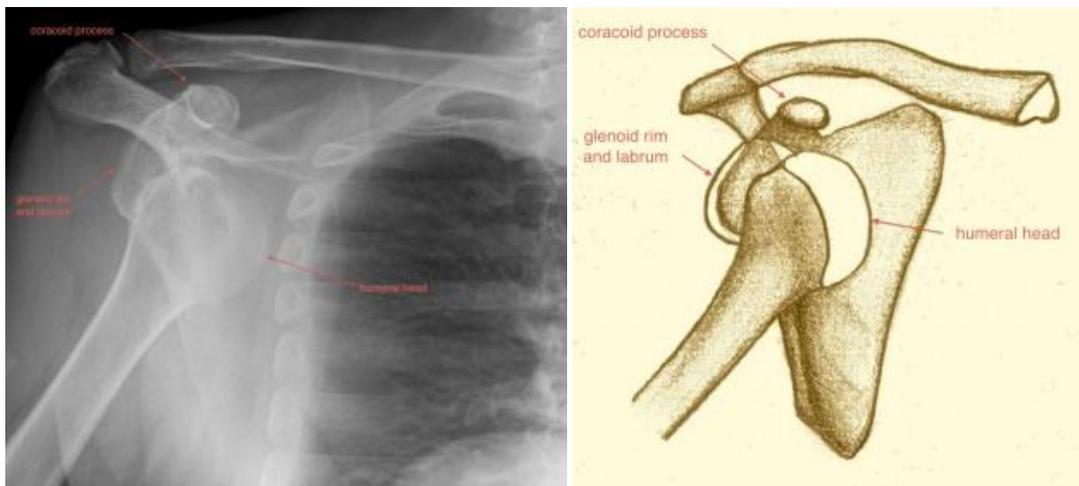


Figure 50 Subcoracoid Dislocation X-Ray and diagram

Subglenoid Dislocation

Subglenoid dislocations occur in about 1/3 of patients with an anterior dislocation. Here the head of the humerus lies anterior and below the glenoid fossa. The majority of these dislocations is associated with a greater tuberosity fracture of the anterior inferior glenoid rim.

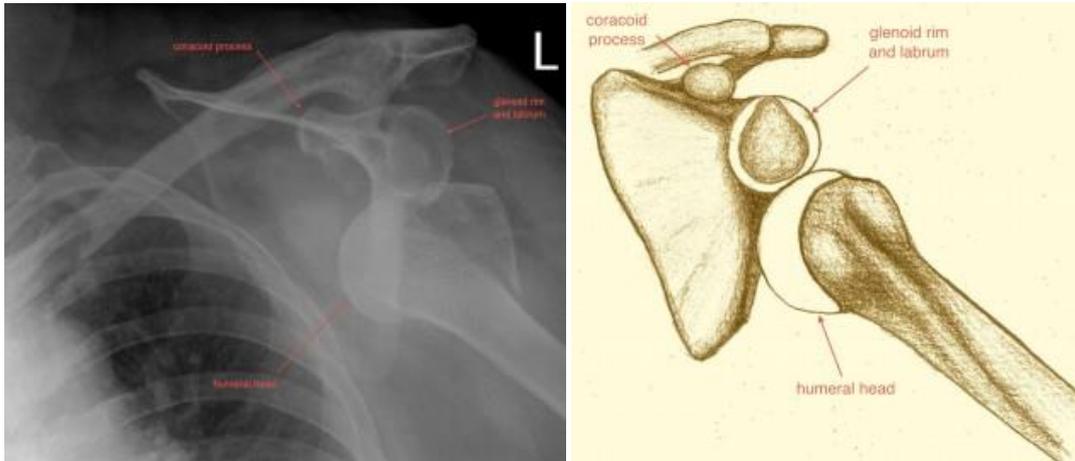


Figure 51 Subglenoid Dislocation X-Ray and diagram

Subclavicular dislocation

With a subclavicular dislocation, the head of the humerus lies medial to the coracoid process, just inferior to the lower border of the clavicle.

Figure 52 Subclavicular dislocation X-ray



Inferior dislocation (luxatio erecta)

With a true inferior dislocation, the humeral head lies inferior to the glenoid fossa. Unlike the subcoracoid dislocation, the superior aspect of the articular surface of the humeral head is directed inferiorly and is not in contact with the inferior glenoid rim.

Figure 53 Inferior Dislocation (Luxatio Erecta)



Also, with this injury, there is severe soft tissue injuries or fractures about the proximal humerus. There may also be an avulsion of the supraspinatus, pectoralis major, or teres minor muscles along with fractures of the greater tuberosity.

Relocation of Dislocations

A dislocated shoulder is an abnormal anatomical configuration and the body will adopt the least painful position available to itself.

Analgesic Position 1

For patients presenting in adduction

The analgesic position is achieved by the following steps.

1. Bring the humerus to full adduction
2. Flex the elbow
3. Provide gentle continuous axial (down the length of the humerus) pressure
4. Wait, and then ask if your patient is more comfortable

Note this is also the starting position for the Cunningham and Kocher's methods. See below for further explanation

Step 1: Sit your patient up (without slouching).



Figure 54 Relocation of dislocation 1

Step 2: The affected arm is adducted (next to the body) and the elbow fully flexed. This optimally shortens the biceps muscle, allowing full relaxation. The humerus points directly down and should be in a neutral position (no forward flexion or external rotation).

Ask the patient to shrug their shoulders, this “squares off” the angle of the shoulder, reducing **scapular anteversion** and so reducing the static obstruction of the glenoid rim

Step 3: Kneel next to your patient and place your wrist onto their forearm, with their hand resting on your shoulder.

Wait, and then ask if your patient is more comfortable. Avoid externally rotating the humerus too much – this can hurt.





The Cunningham Method

To maximize the chance of success, Dr. Cunningham takes time to prepare the patient before laying a hand on him. “Explaining to a patient what you are going to do and that you are not going to pull their arm at any point is really important to reduce anxiety,” he says.

Instead of supporting underneath the affected limb, he grips the forearm or elbow with gentle but steady pressure, which moves the humeral head back slightly toward its usual position, which reduces the patient's pain. ” Encouraging the patient to relax verbally and with massage, followed by slow, gentle movements will allow you to get to your starting position,” he said.

With some patients, you'll never get to this point — they're simply too agitated to attempt a technique like this. For them, analgesia and sedation is a must. “Using drugs in these patients is a recognition that muscle relaxation is going to be impossible otherwise, meaning that either your chosen technique will not work, or you will hurt your patient as they fight any movement you attempt,” Dr. Cunningham said. “Once you have sedated your patient, it is then important to use a technique suitable for your patient, not just pulling hard.”

The hardest part of the technique, Dr. Cunningham said, has been convincing others that it works. “There has been such a reliance on drugs and traction techniques that it can be difficult to persuade some people to change their thinking. But anyone who has reduced a shoulder within a couple of minutes with no drugs and no pain will certainly see the benefits of a non-traction technique.”

Method

How does it work?

This technique uses a combination of positioning and specific massage of the spasming biceps muscle.

How does it overcome the static and dynamic forces?

Static obstruction is overcome by asking the patient to **shrug the shoulders** superiorly (up) and posteriorly (back) which “squares off” the angle of the shoulder (reducing scapular anteversion).

The **dynamic obstruction** of the spasming biceps is actively reduced by **massaging** the muscle at the mid-humeral level.

The starting point for this is with the arm in the anatomical position (adducted). This can be difficult or impossible in obese patients. Then get the patient comfortable by moving the affected arm into the analgesic position

The starting point for this is with the arm in the anatomical position (adducted). This can be difficult or impossible in obese patients. Then get the patient comfortable by moving the affected arm into the analgesic position





Figure 55 Cunningham Method of Shoulder Relocation

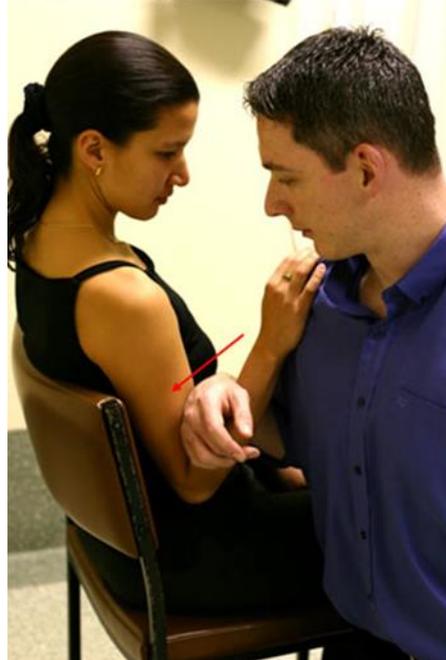
Face directly opposite to the patient and kneel next to them – this avoids any external rotation/flexion of the humerus (which happens if you start off too far away from your patient).

This closeness to the patient also means that they are resting their hand on your shoulder, not reaching for it and clutching with the fingers.

With the humerus adducted, the biceps shortened and the operator's wrist resting on the patient's forearm, the patient will usually immediately feel more comfortable.

The humerus can be gently moved forwards and back in order to find the perfect angle.

Don't pull, you'll only get spasm, pain and an uncooperative patient.



Ask your patient to shrug the shoulders (superiorly/ posteriorly)

Massage the biceps (gently) at mid humeral level

Wait for your patient to fully relax and the humeral head slips back into place

Tell your patient that they will feel "strange" as the joint slips back in and not to fight this movement

Kocher's Method

Method

This technique externally rotates the humeral head, and then lifts it anteriorly past the glenoid rim back into place

How does it overcome the static and dynamic forces?

The humeral head is externally rotated presenting a greater articular surface superiorly allowing it to roll past the glenoid rim back into place. Reduction will often occur during external rotation if the patient is correctly positioned ("shoulders back, chest out, humerus fully adducted") and there is nothing to gain by forcing external rotation once the limit is reached.

In full external rotation the posterior aspect of the greater tuberosity is in contact with the rim of the socket and this is then used as a fulcrum for the next two manoeuvres. The humerus is lifted in the sagittal plane (move the elbow anteriorly and up): this reduces the tension on the joint capsule; and part of the humeral joint surface is lifted onto the anterior rim of the glenoid. Internal rotation is then used to slide the head back into the socket.

Generalised spasm can be reduced by careful slow positioning of your patient.

This technique externally rotates the humeral head, and then lifts it anteriorly past the glenoid rim back into place

Step 1 – positioning

The starting point for this is with the arm in the anatomical position (adducted), this can be difficult or impossible in obese patients.



Figure 56 Kocher's Method of Shoulder Relocation

Sit the patient up in a hard-backed chair

Bend the arm at the elbow; press (adduct) it against the body with the elbow flexed to a right angle

The humerus should be in a neutral position with no forward flexion or external rotation



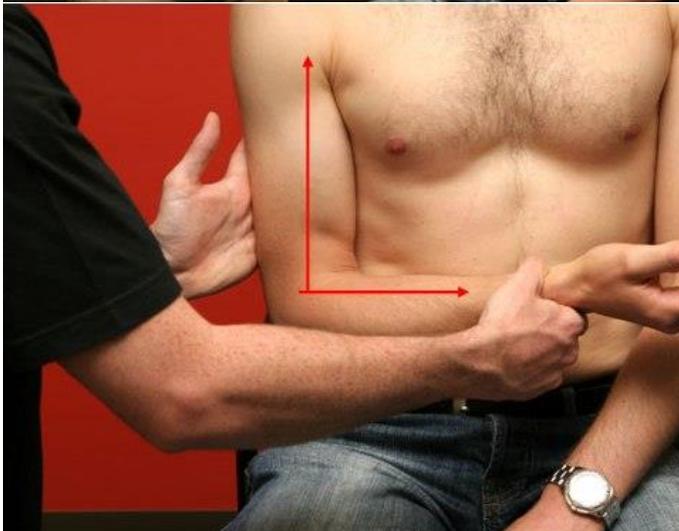
Rotate outwards slowly until resistance is felt



In the sagittal plane, lift the arm as far forwards as possible



Move the humerus forwards, keeping the elbow flexed at 90°



Finally turn the arm in slowly, keeping the elbow flexed at 90°

Remember the scapula!

You may need to ask your patient to shrug the shoulders, bringing the scapulae together (as in the Cunningham technique) – if the scapula is fully anteverted and rotated around on the chest wall then the humeral head will not be able to “roll around” the humeral head even in full external rotation.

Don't pull!

This method has been a reliable, successful technique since 1870 (perhaps longer) and **does not mention traction**. If you add traction, as many have done, you will inflict pain and you run the risk of stress on the humeral neck and shaft which may fracture. Also, you won't be able to reduce your patient's dislocated shoulder!

Anatomically, there is nothing to be gained by forcing external rotation other than pain and spiral fractures. There is usually a point at which either no further external rotation will occur, or the patient will say stop (as you have instructed them to do so!)

Analgesic Position 2

For patients presenting induction

The analgesic position is variable dependent upon the position of the scapula – humeral interface. The patient is usually holding the humerus in abduction and external rotation.

1. Gently externally rotate the arm, and gently abduct the arm to between 30 and 100 degrees of abduction
2. Provide gentle continuous axial (down the length of the humerus) pressure
3. Wait, and then ask if your patient is more comfortable

Note this is also the starting position for the Modified Milch and Scapula Manipulation methods. See below for further explanation

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Note this is also the starting position for the Modified **Milch** and **Scapula Manipulation** methods. See below for further explanation

Figure 57 Analgesic Position

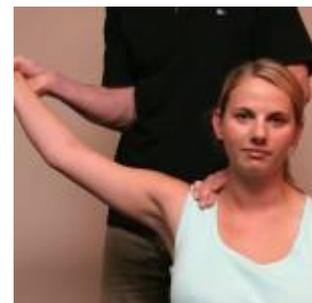
2

Step 1: Sit your patient up (without slouching).

Step 2: The affected arm is gently abducted (away from the body) and externally rotated. Note: The angle of humeral abduction is variable dependent upon the position of the scapula/ humeral interface – this angle may be between 30 and 100 degrees of abduction

Step 3: Add gentle continuous axial (down the length of the humerus) pressure.

Step 4: Wait, and then ask if your patient is more comfortable



Modified Milch Method (back)

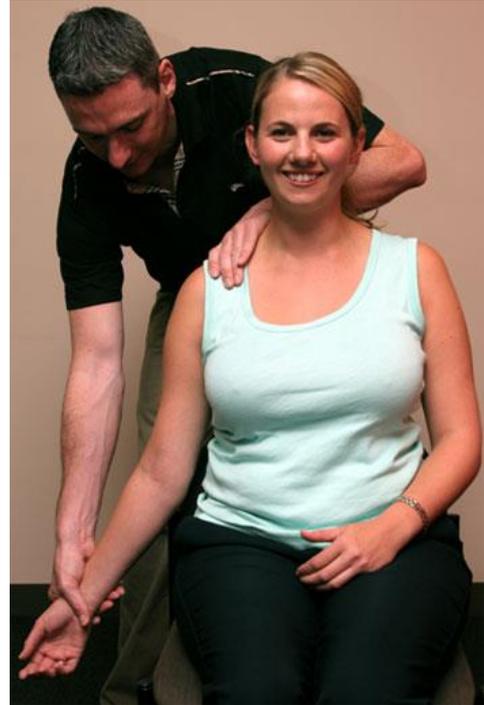
Method

This technique uses a combination of scapular fixation and positioning the humerus in the Zero Position. It is useful for patients who are in abduction already, as is the Scapular Manipulation Method.

Step 1 – Positioning

The starting point for this is with the patients arm in abduction and is useful if your patient cannot adduct

- Sit your patient in a hard-backed chair and stand behind the affected limb.
- Place your left hand over the trapezius and spine of scapula.
- This fixes the scapula and informs you of any scapular movement during the procedure.
- Aim to get your patient comfortable by finding Analgesic Position 2.



Step 2 – Abduction and External Rotation

Hold the right arm by the wrist
Slowly and gently abduct to 100°. Gradually externally rotate as the arm is lifted.

Step 3 – Push the Humeral Head

The humeral head may be gently pushed anteriorly (by your thumb or an assistant) if the relocation does not occur

You also have the option of utilising the modified Milch method from the front.



Scapula Manipulation Technique

Method

This technique fixes the humeral head in position and then rotates the scapula around the head into position.

Figure 58 Scapular Manipulation Technique



How does it overcome the static and dynamic forces?

Constant traction is applied to the externally rotated humerus, this takes humeral head pressure off the glenoid rim (which is sitting above and lateral to the dislocated head).

The inferior tip of the scapula is then rotated bringing the scapular neck and glenoid fossa back into position.

Step 1 – Positioning

The starting point for this is with the arm in 90° of forward flexion and externally rotated

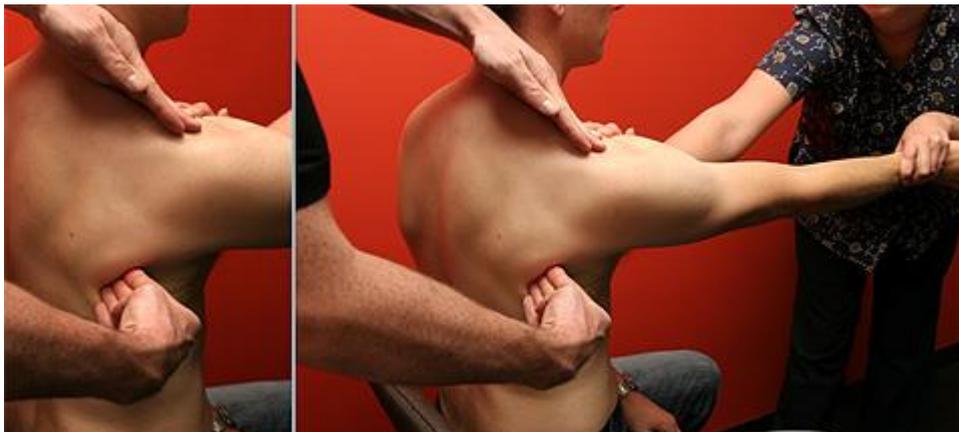
This provides the largest surface area of humeral head articular cartilage to the glenoid rim

Step 2 – Apply Gentle traction



Steady gentle traction on the forearm is maintained (5 -15 lbs) until your patient relaxes. Rest on the clavicle to steady the arm (and yourself)

Step 3 – Rotate the scapula



After the patient begins to relax, rotate the scapula:

Inferior tip – push medially

Superior scapula – push laterally

Remember the scapula here!

Again, the position of the scapula in relation to the humeral head is the key.

This technique was originally described in 1979 (Bosley) with the patient prone, this is often impossible with elderly, obese or distressed patients. Two operators and a seated patient is probably the easiest option but prone (with weights giving traction) or supine are alternatives.

Don't pull!

There is a big difference between steady maintained traction and repetitive yanking which will just cause pain, spasm and failure of your relocation attempt.

As dislocation can cause disruption, i.e. damage, of the primary stabilising structures of the glenohumeral joint, it can predispose to its recurrence sometime in the future. Here, though, the person's age in dislocation recurrence is important:

- under 18 years of age 90%
- under 30 65%
- Over 35 20%

Hence the older the patient is at the time of dislocation, the less likely it is to recur.

Subluxations

A shoulder subluxation is like a shoulder dislocation, the difference being that a subluxation is temporary and partial. It can be described as shoulder joint instability.

Bankart Lesion

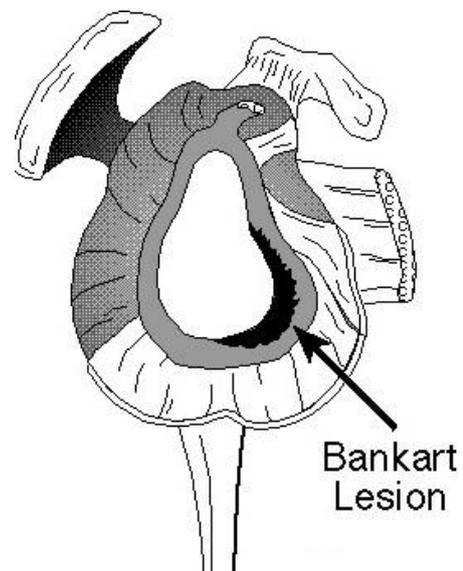
This is an avulsion of the anterior/inferior glenoid labrum at its attachment to the inferior glenohumeral ligament (IGHL) complex.

Figure 59 Bankart Lesion

It probably results from a traumatic external rotation with abduction of the glenohumeral joint. This causes the posterior elements of the humeral head coming into forced contact with the anterior edge of the glenoid fossa. This can cause an anterior dislocation and can be a main cause in recurrent anterior instability as, when this happens, a pocket at the front of the glenoid forms that allows the humeral head to dislocate into it

When it occurs, there is a concomitant capsular disruption, with stretching or elongation of the IGHL.

Of these up to 30% of patients with IGHL will heal in a redundant position. If the trauma is significant, it can also cause a *fracture* of the anteroinferior edge of the bony edge of the glenoid fossa



Hill-Sachs Lesion

This is a lesion that results from a forces extension/abduction lesion. This causes the posterior humeral head to be forced against the anterior/inferior glenoid labrum (and can occur alongside a Bankart lesion). It results in a posterior/lateral indentation in the head of the humerus, occurring from an anterior shoulder dislocation. It can be seen as a local compression fracture as here the soft base of the humeral head impacts against the relatively hard glenoid rim. It occurs in about 35-40% of anterior dislocations and up to 80% of recurrent dislocations. It may destabilise the glenohumeral joint and predispose to future dislocations.



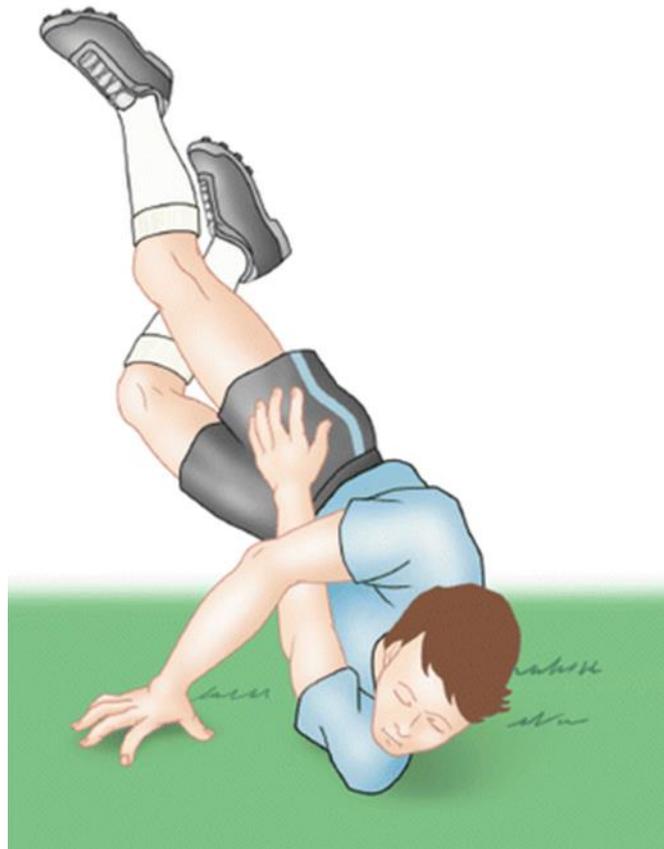
Figure 61 Hill Sachs Lesion on X-Ray

Figure 60 Hill-Sachs Lesion



Acromioclavicular Separations

Acromioclavicular dislocations frequently occur from direct trauma to the top of the shoulder, e.g. in contact sports. Dislocations are classified in 6 grades. Of these grades I and II are incomplete and grades III - VI are varying grades of complete dislocation.



- **Type I:** Mild subluxation only involving a sprain of the capsular ligament.
- **Type II:** This is a tear of the capsular ligament but the important coracoclavicular ligaments may still be intact.
- **Type III:** The coracoclavicular and capsular ligaments are torn. This is the most common injury.
- **Type IV:** The tip of the clavicle is displaced to the rear.
- **Type V:** This is a severe upward displacement with the tip of the clavicle protruding up through the overlying trapezius muscle.
- **Type VI:** This is a downward displacement of the clavicle

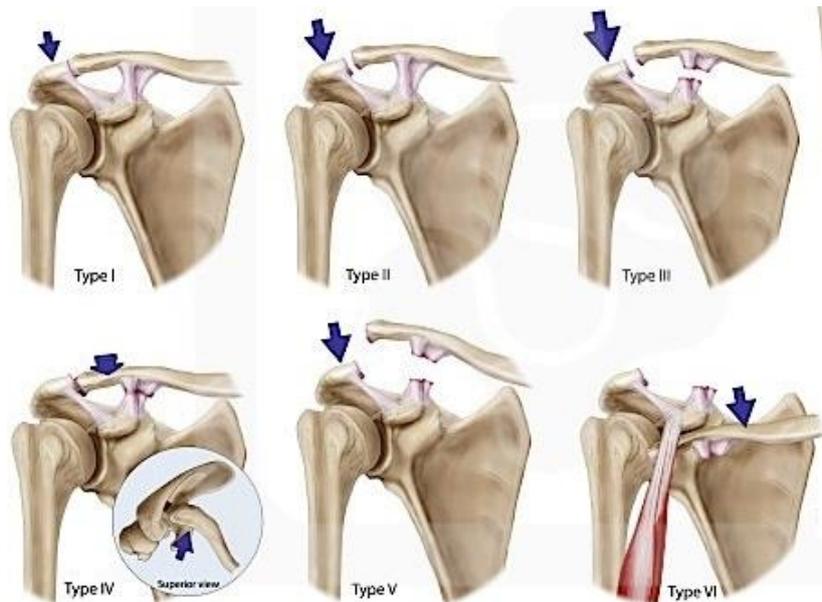


Figure 62 Acromioclavicular dislocations

Symptoms and signs

- Tenderness and swelling over the A/C joint
- Outer end of clavicle is elevated, creating a 'ledge' between it and the acromion
- Provocative movements elicit pain, e.g. downward traction of the arm



Figure 63 Dislocation AC Appearance

X-Ray Diagnosis of Acromioclavicular dislocation

Acromioclavicular dislocation can be diagnosed via X-Ray, here via obtaining a Zanca radiograph. The X-ray beam is aimed directly towards the AC joint with 10–15° of cephalad angulation. The X-ray beam can also be centred on the midline with cephalad angulation to obtain an image that includes the bilateral AC joints

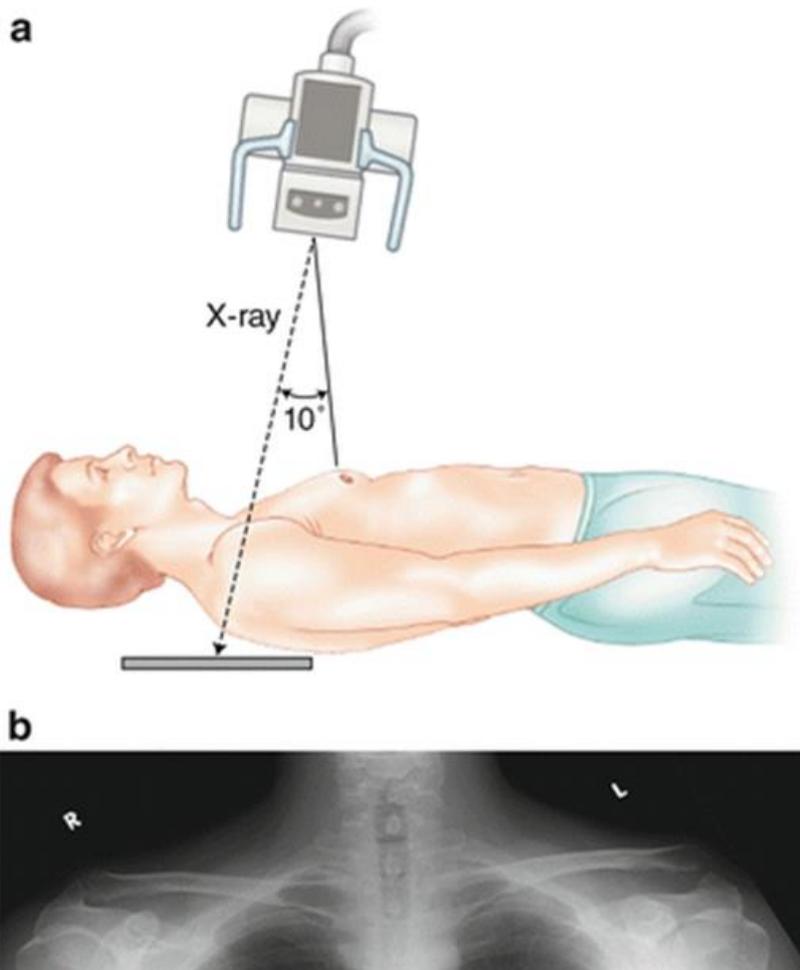


Figure 64 Acromioclavicular dislocation X-Ray

Treatment

Most of these will heal spontaneously but can be helped by immobilisation in a sling.

These can be very painful injuries. Ice packs, anti-inflammatory drugs and a sling are used to immobilise the shoulder and take the weight of the arm. As pain starts to subside, it is important to begin moving the fingers, wrist and elbow to prevent stiffness. Next, it is important to begin shoulder motion to prevent shoulder stiffness.

Undisplaced injuries only require rest, ice, and then gradual return to activity over a 2-6-week period. Major dislocations require surgical stabilisation in athletes if their dominant arm is involved, and if they participate in upper-limb sports.

Surgery is, happily, rarely indicated

Chronic dislocations can result in calcification of the coracoclavicular ligaments.

Calcification is frequently found incidentally on X-Ray examination. The calcification doesn't reach the ends of the ligament and, generally speaking, it does not affect the functioning of the joint.

Degeneration of Acromioclavicular Joint

Normal degeneration of the intra-articular disk begins during adolescence and progresses through the fourth decade, at which point the disk has become a vestigial structure. Degeneration of the intra-articular disk has been associated with osteoarthritis of the AC joint; however, this finding is inevitable since disk degeneration appears to be nearly universal in normal adults.

Illustration highlighting the intra-articular structure of the AC joint. The intra-articular disk typically adheres to the acromial side of the joint. The AC joint capsule inserts between 3 and 5mm lateral to the acromial articular surface and between 3 and 6 mm medial to the clavicular articular surface.

Sternoclavicular Joint Dislocations

The sternoclavicular joint is a freely moveable saddle joint and dislocations here are less frequent than the acromioclavicular joint.

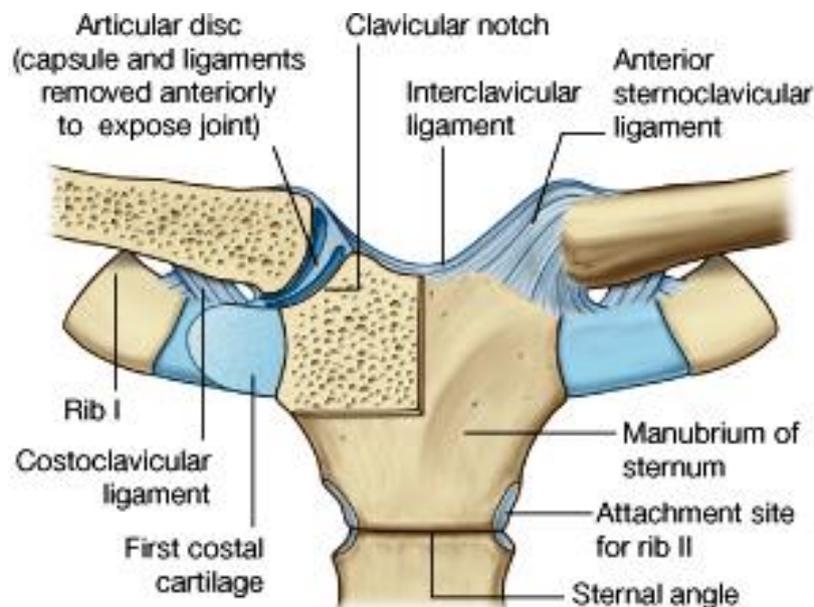


Figure 65 Sternoclavicular Joint

Sternoclavicular dislocations are generally uncommon. In the US a survey of 1603 shoulder girdle injuries. Only 3% were S/C dislocations. Of these posterior ones were the least common; only 1 of the 1603 was a posterior one.

Mechanism of injury

- Direct fall on shoulder
- Fall on elbow (on abducted arm)
- Both of these involve a force medially along the axis of the clavicle, with a posterior force at its lateral end (creating an anterior force at the medial end).

Types of dislocation

Anterior

This is the most common variety. They may occur spontaneously without any history trauma (but rarely). If traumatic, it may be caused by an indirect mechanism, such as a blow to the anterior shoulder. Older patients may present with painless sternal mass. They all affect the sternal end of clavicle

Posterior

- Less common cf anterior
- Rarely causes compression of the anterior neck
- Can lead to dyspnoea and vascular compression
- Will require surgical reduction

Superior

- Not common
- Due to ligamentous attachments between clavicle and the first rib, there may be rib symptoms as the primary complaint: acute shoulder pain, acute pain with coughing laughing and sneezing and deep breathing

Symptoms and signs

Tenderness at sternoclavicular joint with possible visible prominence at sternal end of clavicle. There will be discomfort with movement.



Figure 66 Sternoclavicular dislocation - Appearance

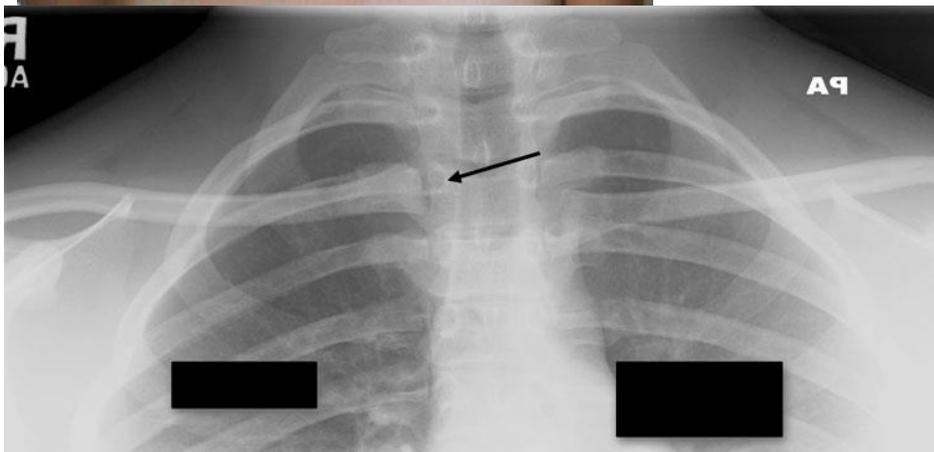


Figure 67
Sternoclavicular
Dislocation X-Ray

X-Rays can be difficult to visualise due to the thoracic spine and aortic arch etc.

Functional Problems

Functional problems of the sternoclavicular joint are frequently due to trauma elsewhere, e.g.

- From a fall on the arm (putting force along the clavicle, causing a dysfunction at the medial end)
- Hypertonic scalenes, pulling up the first rib and pulling the clavicle with it
- Hypertonic sternocleidomastoid (maybe from a torticollis), pulling on the medial end of the clavicle
- Left sternoclavicular problems can be a referred symptom from stomach visceral dysfunction

These may manifest as local pain and dysfunction, or as 1st rib dysfunction: acute pain with coughing, laughing, sneezing and deep breathing.

These can be corrected by giving attention to the relevant tissues and local adjustment of the S/C joint, or via traction techniques via the arm and fixing on the medial head of the clavicle.

Frozen Shoulder

Frozen shoulder is also known as adhesive capsulitis.

The 'classical' presentation of frozen shoulder is **severe** pain and gross limitation of movement of the glenohumeral joint, particularly with abduction and internal rotation (as internal rotation is less than external rotation, any loss is more significant). There is significant fear of any articulation with both active and passive movements. The patient will present guarding the arm, or even have it in a sling. They will avoid any activity that may cause pain, purely because of the severity of the pain. Even turning onto the affected side during sleep will cause the patient to awake with pain, hence affecting their sleep cycle as well.

Any incident that is minor to a normal person will be significant to them, e.g. walking through a doorway and 'knocking' the shoulder on the doorframe would not affect you or I, but their shoulder would explode with pain, with that pain continuing for possibly 10 minutes afterwards. With this knowledge, examination of such a person must be approached with great care.

Some authorities claim that a frozen shoulder is a chronic condition. Generally:

- **Stage 1:** Inflammation (0-3 months). The lining of the joint (synovium) is inflamed. Moderately severe pain
- **Stage 2:** Freezing Stage (3-9 months) Synovitis and scar formation in the underlying capsule. Severe pain.
- **Stage 3:** Frozen Stage (9-15 months). Minimal pain marked stiffness due to scar formation in capsule.
- **Stage 4:** Thawing Stage (15-24 months). Little pain, movement increases.

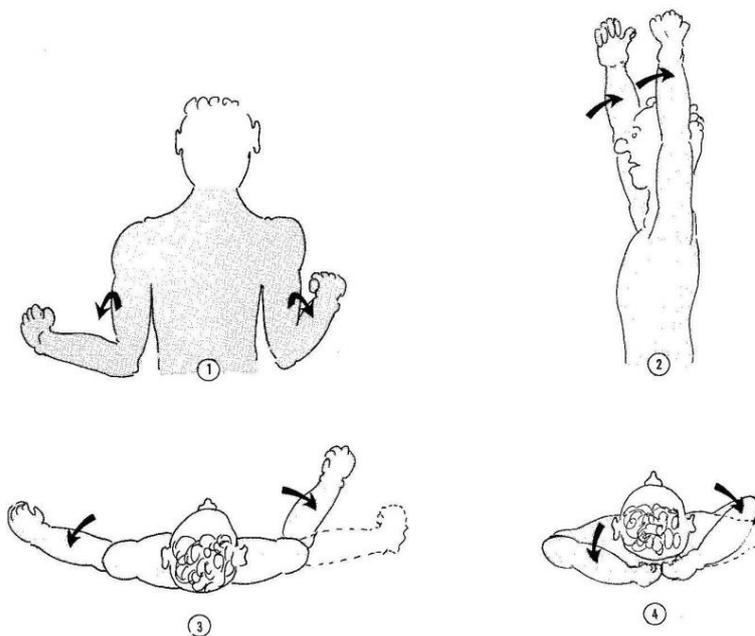


Figure 68 Early Frozen Shoulder

However, there are subtle signs of 'minor' frozen shoulder that can be missed is the patient presents very early in the progression of the condition.

These signs can be missed or confused with a 'stiff' shoulder; a slight limitation of capsular elasticity and prevents proper glenohumeral movement. Here pain can be elicited at the end point of all shoulder motion; both passive and active.

It has been established in neurophysiologic studies that painful afferent impulses from articular tissues, of which the capsule is one, inhibit neuromuscular strength and the arm is noted to be weak.

Strengthening exercises are fraught with failure as long as there is end-point pain, albeit minor. People will avoid pain and painful arcs of movement and will frequent use this excuse to avoid doing mobility exercises.

A person's psychological profile and subjective pain threshold are also significant in these cases. If a person has a **lower** pain threshold, the more guarding and limitation of movement is likely; this is because the person is less likely to go to the limits of movement with either active or passive articulation. This fear of articulation can induce **more** tension in the relevant muscle groups, causing **more** restriction.

I have found that if a person has a high pain threshold, they are more of a 'happy go lucky' temperament and more tolerant of situations in life overall. However, a person of a low pain threshold have a lower threshold to life in general; possibly a 'whiner' and will complain about any treatment administered. It may even be that they do not accept any responsibility for their condition or recovery at all; it's not part of them, but a suffering that has been thrust upon them and thus are not willing to do any exercises prescribed ("You get me better").

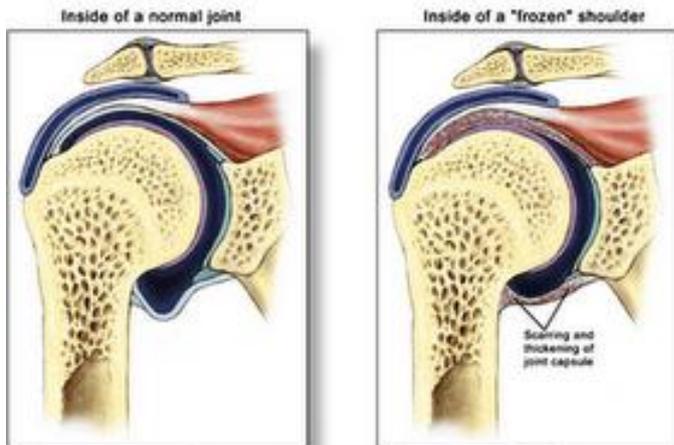


Figure 69 Frozen shoulder joint compared with normal

In Fig 65, the diagram on the left shows a normal glenohumeral joint, whereas the one on the right is a frozen shoulder. Note with the frozen shoulder, the joint capsule is smaller now only containing about 0.5ml - 3ml of synovial fluid compared with the normal of 30ml. The frozen shoulder also demonstrates less flaccid

capsule on the inferior side of the joint. This with the reduced amount of synovial fluid, along with any inflammation present, will contribute to the reduced range of movement and significant pain barriers.

Manifestations of frozen shoulder

Figure 70 Limitation of Internal Rotation

Internal rotation is always limited, as shown in Fig 66. The normal range of movement can reach up to between the shoulder blades, whereas the bad shoulder can barely reach behind the back. This will manifest in difficulty in dressing (tucking the shirt in or doing up the bra) with compensation behaviour.

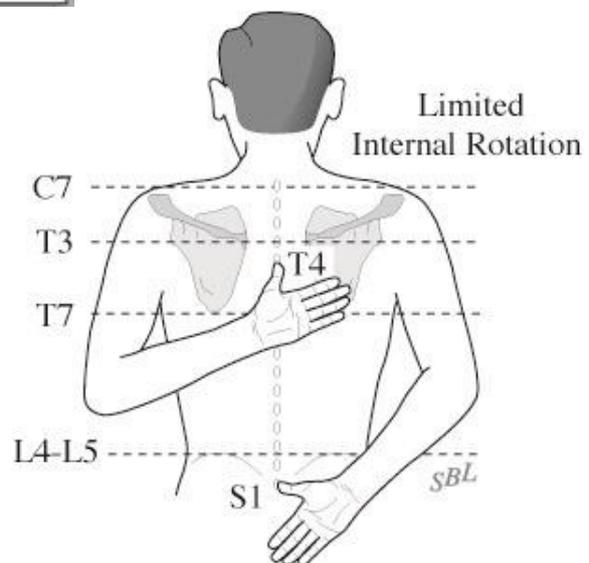




Figure 71 Classical presentation of Frozen Shoulder with Bilateral Active Flexion

Flexion and abduction are usually severely limited, with the person demonstrating the characteristic 'shrug' of the shoulder on the affected side.



Figure 72 Limitation of External Rotation

External rotation is also severely limited



Figure 73 A protruding shoulder blade

With the pain of any abduction, the arm will be fixed to the right. This picture demonstrates 'pseudo-winging of the scapula' as a manifestation of this.

Who is at risk?

- Females are more affected than males
- The usual onset is 40 - 65 years of age
- 10 - 20% of diabetics are affected

Predisposing factors

- Enforced immobility
- Trauma
 - Falling on an outstretched arm
 - Reaching into the back of the car
- Overuse injury
- Surgery
- Hyperthyroidism
- Cardiovascular disease
- Clinical depression
- Parkinsonism

Despite all these, the cause of a frozen shoulder is unknown

- There is almost certainly an underlying inflammatory process
 - Hence the pain suffered
- The capsule of the joint thickens and contracts
 - Hence less space for movement
- Usually only one shoulder is affected

Conventional treatment

- Medication (aspirin, paracetamol, brufen, Difene) to reduce inflammation and relieve pain
- Muscle relaxants (Valium) as a psychological relaxant, but is only administered in short courses
- Heat or cold therapy
- Corticosteroid injections
- A program of physical therapy, to encourage and maintain mobility
- Home exercises, to be done several times a day

Surgical intervention isn't often performed as physiotherapy is preferred

Physical therapy treatment

Corticosteroid injections are not often effective in pain reduction and patients will seek other types of pain reduction. This may be an essential step, else the patient will not do any prescribed exercises.

Exercises

The main objective is to continue and maintain all ranges of movement within the pain threshold.

Figure 74 Pendulum Exercise

The pendulum exercise is easily performed. The person stands beside a table and supports themselves with their good arm with the bad one hanging. Then swing it to and fro, front to back.





Figure 75 Pendulum Exercise 2

The pendulum exercise can be modified with the arm swung in a circle one way, then the other.

These can be gentle emphasised by the person holding a small weight (even just a large tin) in their hand, creating a slight traction along the axis of the arm.

Figure 76 External rotation

Rotation of the shoulder can be encouraged by using a broomstick. Hold the broomstick with both hands and move them to the left and right. The movements should be gentle and linear, respecting the barriers.

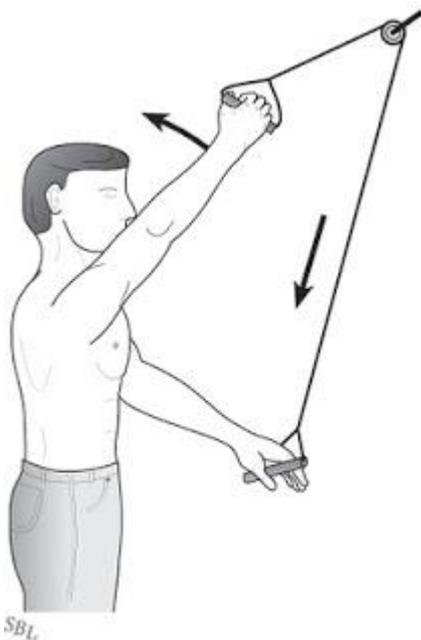


Figure 77 The Door Pulley

This dynamic exercise can be used to encourage flexion and extension of the shoulder. It should be performed with the arms **straight**. Here again, it should be performed within the pain barriers (especially in the acute phase)

Figure 78 Adduction exercise

The adduction exercise can be used to help, not only the range of movement of the shoulder, but to help the mobility of the scapula forward and around the body.



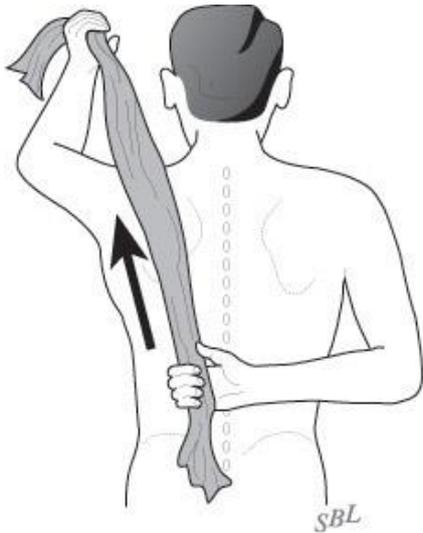


Figure 79 Towel exercise

The towel exercise will be of great use, especially when the acute phase has passed. It will help internal rotation.

Hold the towel and gently pull the affected arm up with the good one.

Reach the beginning of tension

Here, either take a deep breath in and hold it for several seconds, or actively pull down with the affected arm

More mobility exercises

These can be performed rotating the shoulders outwards, then inwards

Put the tops of your fingers on the tops of your shoulders
 Rotating elbows **backwards**
 Bring your elbows together at the front - **breathe in**
 Rotate your elbows up and backwards - **breathe out**
 Repeat for 6 breaths



Breathe In



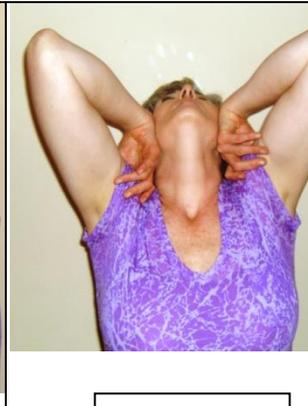
Breathe In



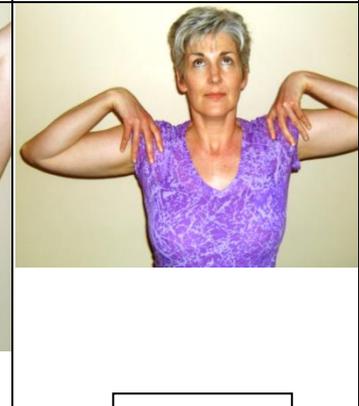
Breathe out



Breathe out



Breathe out



Breathe in

Figure 80 Mobility exercises for shoulders

There is one more exercise that is a little more dynamic (moving) in nature. I affectionately call it the Kung Fu exercise. It is designed for the shoulders and arms. Again, this is a **breathing** exercise, with movement. This exercise is like reaching out and **plucking a piece of fruit** from a tree

- a) Stand with your feet shoulder width apart
- b) Place your hands at your sides, palms up, slightly above waist height
- c) **Gently** clench your fists
- d) Begin to reach your left-hand forwards: unclench that hand and rotate it **inwards** such that your palm is facing away to your **left**
- e) Reach that hand as far forward as you can (reach for the fruit)
- f) At full stretch, open your hand wide and rotate it **outwards** so that your palm is now facing **upwards** (plucking the fruit)
- g) Gently clench your hand again (grasping the fruit)
- h) Pull your hand back to your side
- i) Repeat with your other hand
- j) Continue for a few minutes

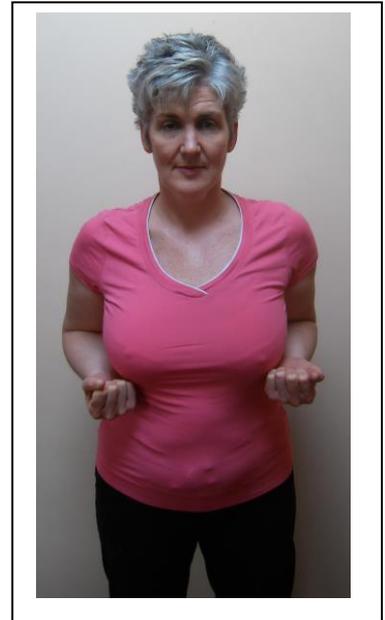


Figure 81 Kung Fu Exercises for shoulders

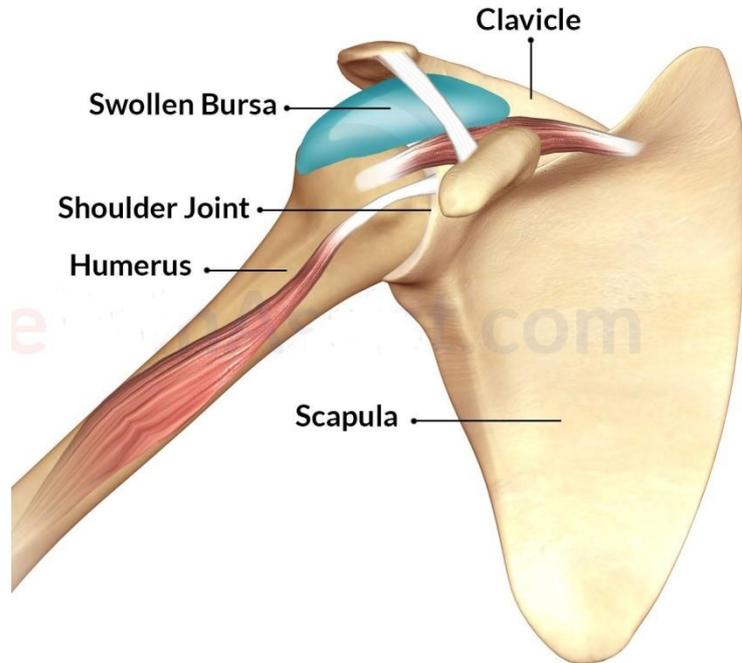
Subacromial Bursitis

Fig 78 shows the subacromial bursa. A bursa is a small pad lined with a synovial membrane. They usually lie between structures that rub over each other regularly, here between the supraspinatus muscle and the overlying acromial process.

Figure 78 The Shoulder Showing the Subacromial Bursa

The subacromial bursa has a large synovial membrane which is:

- Adherent to the under-surface of the coracoacromial ligament and deltoid muscle
- Under the deltoid muscle, laterally
- Adherent to the rotator cuff and greater tuberosity
- Envelops the proximal humerus



Symptoms

- Gradual onset of your shoulder symptoms over weeks or months.
- Pain on the outside of your shoulder.
- Pain may spread down your arm towards the elbow or wrist.
- Pain made worse when lying on your affected shoulder.
- Pain made worse when using your arm above your head.
- Painful arc of movement – shoulder pain felt between 70° - 120° of arm moving up and outwards.
- When your arm is by your side there is minimal pain and above 120° relief of pain.
- Shoulder pain with activities such as washing hair, reaching up to high shelf in the cupboard

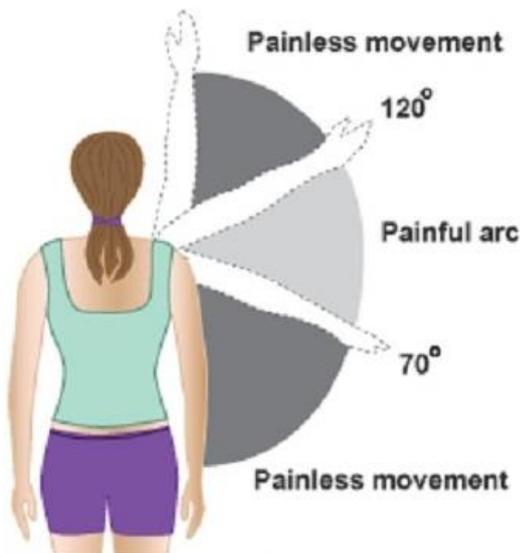


Figure 82 Subacromial Bursitis Painful Arc of Movement

Pain is elicited from compression of the subacromial bursa by the greater tuberosity against the acromion. To allow full abduction, the humerus rotates laterally to take the tuberosity behind the acromion, relieving the pressure on the bursa.

Causes

- It can be irritated or inflamed by a rotator cuff injury
- Overuse injury of the rotator cuff
- Calcium deposits on supraspinatus
- Secondary to inflammation of supraspinatus tendon

It can be seen here that it can be confused with supraspinatus tendinitis, except that with the tendinitis, the painful arc of movement would be greater (i.e. even from initiation of abduction with the arm at the side)

Treatment

A) Rest

1. Avoidance of the activity
2. Modify the voluntary actions that exacerbate the symptoms
3. Graduated conditioning prior to return to activity

B) Stretching and ROM exercises

1. Relieves the posterior capsular tightness
2. Avoids any increase to frozen shoulder

C) Strengthening exercises

1. Especially internal and external exercises, to strengthen the humeral head depressors
2. Avoid exercises above the level of the shoulder that could cause impingement

D) NSAI's

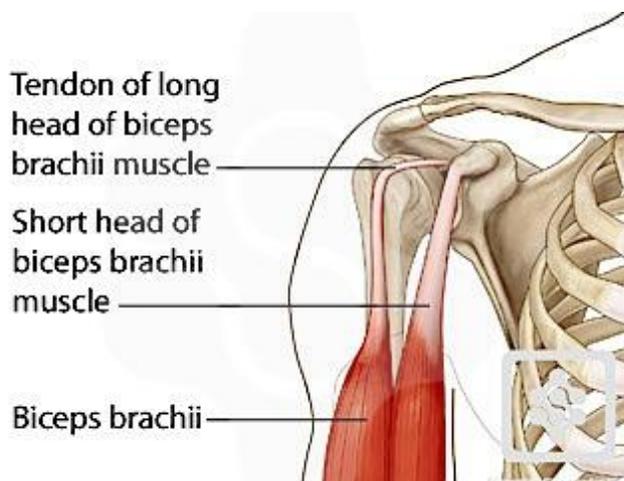
E) Ice, heat, and massage

F) Electrotherapy (ultrasound)

G) Local steroid injection

Ruptured Long Head of Biceps

The biceps muscle is not strictly speaking part of the shoulder, but as both heads of biceps brachii originate from above the glenohumeral joint, it can be included here.



The **short head** of biceps arises from the coracoid process of the scapula

The **long head** arises from the supraglenoid tubercle, just above the glenoid fossa. It passes through the joint capsule of the glenohumeral joint and then down in the intertubercular groove. The 2 muscle bellies unite near the mid-shaft of the humerus and attach distally on the radial tuberosity. The distal tendon blends with the bicipital aponeurosis, which affords protection to structures of the cubital fossa, allowing distribution of

forces across the elbow to lessen the pull on the radial tuberosity.

Tendon ruptures of the biceps brachii, one of the dominant muscles of the arm, have been reported in the United States with increasing frequency. Ruptures of the proximal biceps tendon make up 90-97% of all biceps ruptures and almost exclusively involve the long head.

Tendon rupture typically occurs at the bony attachment or tendon-labral junction. The remaining ruptures occur distally at the insertion on the radial tuberosity or, even less commonly, at the short-head insertion on the acromion. The injury is experienced mostly by individuals aged 40-60 years with a history of shoulder problems, secondary to chronic wear of the tendon. Younger individuals may rupture the biceps tendon following a traumatic fall, during heavy weightlifting, or during sporting activities (e.g., snowboarding, football). The result of this is that the muscle can still contract, but the long head is no longer fixed at its superior end and so is pulled down into the belly of the muscle, resulting in a 'Popeye' appearance (Fig 69)

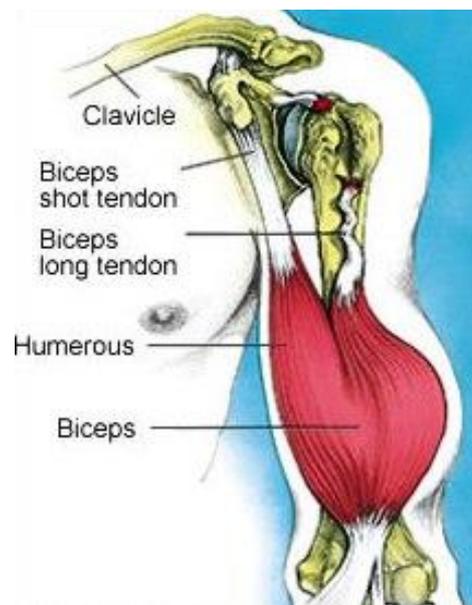


Figure 83 Diagram of Rupture of Long Head of Biceps

Overall consequences of biceps rupture may differ among various demographic groups. The major impairment resulting from proximal biceps rupture involves limitations due to pain during the acute phase, but impairment ultimately relates to a decrease in strength during shoulder flexion, elbow flexion, and forearm supination. Distal ruptures also initially result in pain, followed by reduced strength in supination, elbow flexion, and grip strength.



Figure 84 Physical Appearance of Ruptured Long Head Biceps

Men suffer biceps rupture more commonly than do women, but this difference may result primarily from vocational or avocational factors. The dominant arm is involved more commonly, probably because it is used more often than is the non-dominant arm. At present, no evidence exists of a male or female predisposition to biceps rupture due to anatomic or genetic factors.

Symptoms include the following:

- Some patients report a sudden pain in the anterior shoulder during activity. This acute pain, frequently described as sharp in nature, may be accompanied by an audible pop or a perceived snapping sensation.
- There may be evidence of bruising, if the site of rupture is low enough
- Other persons may report experiencing recurrent pain while performing overhead or repetitive activities.
- Still others experience a nondescript anterior shoulder soreness that may worsen at night.
- Patients also may be asymptomatic and note only a visible or palpable mass between the shoulder and elbow. Pain actually may diminish when complete rupture occurs following chronic impingement and irritation. Distal ruptures may present in a similar fashion, but in most of these cases, symptoms or noticeable masses are located closer to the elbow.

Causes

- A proximal biceps rupture generally is caused by insidious inflammation from impingement in the subacromial region and may be the eventual result of chronic microtrauma in this manner. Repeated insults often lead to fraying of the tendon, with resultant weakness predisposing it to rupture following relatively minor injuries.
- A tendon rupture due to chronic inflammation can occur in rheumatoid arthritis.
- Excessive loading or rapid stress upon the tendon, such as in weightlifting, often causes an acute tendon rupture.
- Biceps tendon rupture or degeneration frequently is associated with rotator cuff trauma in the geriatric population and is often observed at the time of surgery for complete rotator cuff tears. This may be related to impingement phenomenon.
- Most ruptures occur at the tendinous insertion to the bony anchor, proximally and distally
- Distal avulsions from the radius commonly are caused by chronic irritation on an irregular surface, such as in persistent cubital bursitis.
- Acute avulsions are the result of forceful extension of the elbow from a flexed and supinated position.
- Rare short-head rupture may occur with rapid flexion and adduction of the arm during elbow extension activities.
- Impairment of physiologic repair mechanisms by medications (statins) has also been proposed as a potential factor predisposing the tendon to rupture.

The condition is not repairable, but the person can still function quite adequately as it is.

Subluxation of the Bicipital Tendon

The long head of the bicipital tendon (the long head of biceps) runs in the groove between the greater and lesser tubercles, the intertubercular groove. As it moves superiorly it arches through the rotator cuff interval (a triangular space between the tendons of subscapularis and supraspinatus and the base of the coracoid process) where it is held by a sling formed by the superior glenohumeral ligament and the coracohumeral ligament. To maintain its position in this groove there is the transverse humeral ligament.

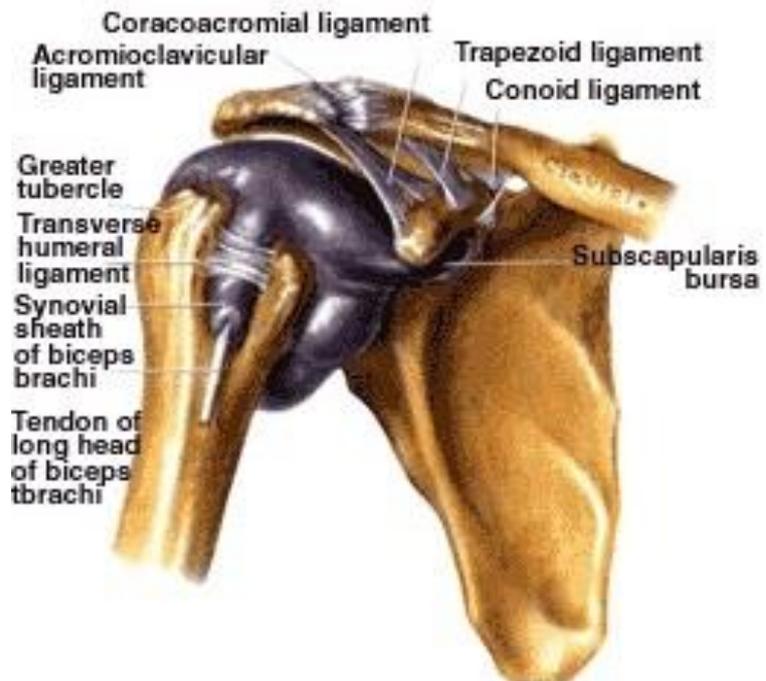


Figure 85 Bicipital Tendon in Bicipital Groove

Infrequently, these soft tissue restraints that maintain the biceps long head tendon position within the groove can be injured, allowing the tendon to *sublux*, or partially dislocate in and out of its groove. This rarely occurs without other shoulder problems. It is most often associated with a partial or complete tear of the subscapularis tendon, the rotator cuff tendon

in the front of the shoulder. Rarely, acute traumatic injury can compromise the tendon sheath over the groove, allowing the tendon to become unstable.

When this ligament is deficient the tendon is free to dislocate medially. If the tendon of the subscapularis is intact then the tendon is seen lying anterior to it. If, as is common, the subscapularis tendon is also deficient then the tendon of the long head of biceps can prolapse into the glenohumeral joint.

What increases the risk?

- Contact sports, throwing sports, weightlifting and bodybuilding
- Heavy labour
- Poor physical conditioning (strength and flexibility)
- Inadequate warm-up before practice or play

What are the symptoms of biceps tendon subluxation?

- Mechanical symptoms such as a “clunk” when rotating the arm inward or outward.
- Pain or discomfort in the front of the shoulder, often referred to the biceps muscle.
- Symptoms due to pathology within the tendon of the subscapularis, including pain in the front of the shoulder and pain with internal rotation (placing the hand behind the back).

How is biceps tendon subluxation diagnosed?

Because it is so uncommon, there are no physical exam tests, which accurately identify this condition. Physical exam findings that may suggest long head biceps pathology, either subluxation or tendon tearing, include

- Tenderness along the bicipital sheath
- Pain with internal rotation
- A positive “Speed’s Sign”
 - Patient upright
 - Affected arm is held out to their front, palm up
 - Push down on arm
 - Any pain in shoulder or overt weakness is positive test

Are there any special tests?

MRI imaging permits visualization of the long head of the biceps tendon. Abnormalities can include degenerative changes and splits within the tendon, and, in the case of subluxation, displacement out of its normal position within the bicipital groove. When this occurs, it reflects pathology and tearing of the upper subscapularis tendon, which serves as a restraint in the biceps tendons’ normal course.

MRI, however, will not detect subluxation that occurs dynamically, because the test is performed with the arm positioned at the side of the body.

Ultrasound may provide a dynamic means by which long head biceps instability is detected. While the ultrasound probe is placed directly over the bicipital groove, the patient’s shoulder is actively and passively moved, directly visualizing changes in the biceps tendons position. For corrections of these, see below.

Manipulations of the Shoulder Region

Glenohumeral Joint

This procedure is for functional subluxations rather than dislocations (see Page 20 et seq.)

Anterior Humeral Head

Patient sitting:

1. Place the hand of the affected side on their opposite shoulder
2. Stand behind the patient, fixing their body against theirs (to fix the scapula)
 - a. This can be helped by placing their affected shoulder into your armpit
3. Reach around and hold their elbow with your hands and supporting the course of their arms with yours
4. Adjust your mutual positioning creating a gentle compression up along the axis of the humerus and perceive the point of tension; where no more movement can be felt, aka preloading
5. The thrust is on their elbow, up along their humerus, into the affected glenohumeral joint

Patient supine - technique preceded by massage to all shoulder muscles

1. Stand on the ipsilateral side as the affected shoulder
2. Hold the affected shoulder with one hand and compress the shoulder backwards to the table
3. Maintain this compression and gently pull the patient's arm across their body, their hand down towards the opposite ASIS
4. The thrust is pushing the shoulder backwards towards the table
 - a. At the same time pulling the arm down to the opposite ASIS
 - b. The contact hand must slide off the shoulder at the same time

Acromioclavicular joint

Clavicle Superior

1. Patient sitting
2. Stand behind patient
3. Flex the elbow on the affected side and fix the arm against their side
4. Fix the top of the A/C joint (at the lateral end of the clavicle)
5. Thrush the lateral end of the clavicle downwards, whilst fixing the arm with an upward compression of the elbow

Clavicle Anterior

1. Patient sitting
2. Stand behind patient
3. Fix on the anterior clavicle on or near the A/C joint
4. Hold the patient's forearm (on its extensor side) and slowly move the arm backwards into adduction and medial rotation
5. Articulate and test the available motion by moving the arm from backwards to forwards
 - a. Moving the arm into flexion, abduction and external rotation
 - b. This test the end point where the HVT will be enacted
6. Perform the HVT by moving the arm forwards quickly to the forward end point, whilst fixing on the clavicle

Bicipital Tendon (long head of Biceps)

1. Patient supine
2. Abduct the affected arm to 90°
3. Flex the elbow to 90°
4. Hold forearm vertical
5. Fix on long head of biceps (it should hurt)
6. Externally rotate arm whilst maintaining point of fixation on bicipital tendon
7. Maintain point of fixation and rotate arm medially again
8. Give attention to post-scapular and periscapular muscles

Sternoclavicular Joint **Clavicular head superior**

A

1. Patient supine
2. Stand on ipsilateral side
3. Fix on medial end of clavicle with pads of fingers
4. Hold the forearm. With their hand resting on your hip
5. Rhythmically tug at the patient's arm whilst fixing on the clavicle
6. You should be able to feel the clavicular head relocate

B- a cross-handed technique

1. Patient supine
2. Stand at the head of the patient
3. Place one hand on the opposite (unaffected) clavicle
4. Place the other hand along the affected clavicle (your arms are now crossed)
5. Thrust the affected clavicle along its shaft away from the good shoulder
 - a. This creates a traction to allow for its relocation
 - b. Also compress the medial end caudad to assist its relocation

Clavicle anterior

A - a cross-handed technique

1. Patient supine
2. Fix the sternum with one hand
3. Then fix on the sternoclavicular and the medial end of the shaft of the clavicle
4. The thrust will push the clavicle laterally and posteriorly

B - a modification; also cross-handed

1. Patient supine
2. One hand on the distal end (in the curvature) of the affected clavicle
3. The other hand fixes the sternum using its M/P joints
 - a. This induces a traction along the clavicle in addition to fixing the sternum
4. The thrust is performed by rolling the hand onto the medial clavicular head