Introduction

Sonography is a useful technique for the investigation of a number of musculoskeletal disorders. Advances in sonographic technology, including higher resolution probes, extended field of view imaging and compound imaging have contributed to expand its clinical applications ***(Khoury et al., 2007).***

Sonography has the well-known advantages of low cost, accessibility, portability, non-invasiveness and multiplanar imaging. But perhaps one of its most important diagnostic advantages over other techniques is its real time imaging capability, allowing for dynamic evaluation ***(Khoury et al., 2007).***

Musculoskeletal ultrasonography (US) of the hands and wrist has recently been increasing in popularity. Recent rapid technical advances in US, such as new ultra high frequency probes and smaller probe sizes, have led to improved image quality. This, in turn, has accelerated the growth of musculoskeletal US ***(Wong et al., 2009).***

Known advantages of US are its lack of ionizing radiation, non invasiveness, portability and low cost. Dynamic and real-time assessments are additional benefits of this modality, especially in the imaging of the hands and wrist ***(Wong et al., 2009).***

Superficial structures of the hands and wrist, including the tendons, ligaments, nerves and vessels, are amenable to imaging with high frequency US ***(Wong et al., 2009).***

Progressive refinement of broadband transducers with frequencies higher than 10 MHz and improved near-field resolution has enhanced the potential of sonography to evaluate a variety of nerve entrapment syndromes occurring in the upper limb ***(Martinoli et al., 2004).***

This could be either suprascapular neuropathy at spinoglenoid-supraspinous notch, the quadrilateral space syndrome (axillary neuropathy), radial neuropathy in the area of the spiral groove and the supinator syndrome (posterior interosseous neuropathy), the cubital tunnel syndrome (ulnar neuropathy) ***(Martinoli et al., 2004).***

In addition the Kiloh-Nevin syndrome (anterior interosseous neuropathy), and in the wrist, carpal tunnel syndrome can be identified. Such high-resolution sonography can depict changes in the nerve's shape and echotexture and extrinsic causes of nerve entrapment ***(Martinoli et al., 2004).***

In shoulder impingement syndrome, pain is generated when the greater tuberosity of the humerus or soft-tissue structures (supraspinatus tendon and subacromialsubdeltoid bursa) encroach on the coracoacromial arch (acromion, coracoacromial ligament, and acromioclavicular joint) in abduction or abduction-flexion internal rotation of the shoulder ***(Khoury et al., 2007).***

Dynamic sonography has been shown to be an ideal diagnostic tool to make the diagnosis of shoulder impingement because it can directly show this dynamic process in addition to evaluating the rotator cuff and other abnormalities known to be associated with impingement ***(Khoury et al., 2007).***

One of the most important prognostic factors in patients with musculoskeletal infections is the delay in establishing therapy. Early diagnosis of septic arthritis requires analysis of joint fluid. Ultrasonography (US) is a rapid, portable, sensitive technique for confirming the presence of joint effusions ***(Bureau et al., 1998).***

Aim of Work

The aim of work is to illustrate a wide variety of musculoskeletal disorders that can be diagnosed with dynamic sonography.

Anatomy of the shoulder joint

The shoulder joint is a ball-and-socket synovial joint in which an elegant freedom of movement is allowed at some expense of its strength and stability ***(Prescher, 2000).***

The bones entering in its formation are the hemispherical head of the humerus (ball) linking to the shallow glenoid cavity of the scapula (socket). Some protection of the joint against displacement is afforded by its ligaments and by the tendons and muscles that surrounds it ***(Prescher, 2000).***

The ligamentous protection supplied by the muscles and tendons effectively limits the degree of movement allowed by the joint. Additional protection superiorly supplied by the arch formed by the coracoid process, acromion, and coraco-acromial ligament ***(Prescher, 2000).***

A-Bones of the shoulder joint (Fig. 1)

The clavicle connects the axial and appendicular skeletons of the upper extremity. Its sternal end is expanded and fits into the notch on the manubrium at the sterno-clavicular joint. The lateral one-third is flat, and its sternal end is expanded as it curves back to meet the scapula at the acromio-clavicular joint ***(Goldstein, 2004).***

The scapula consists of the scapular body, the scapular spine, the scapular neck, the acromion, the glenoid fossa, and the coracoid process. It has costal (anterior) and posterior surfaces with its anterior surface in contact with the thoracic cage (the scapula-thoracic interface) ***(Goldstein, 2004).***

From the upper part of the posterior surface, the spine of the scapula projects laterally, terminating into the acromion, which forms the lateral most tip of the shoulder ***(Goldstein, 2004).***

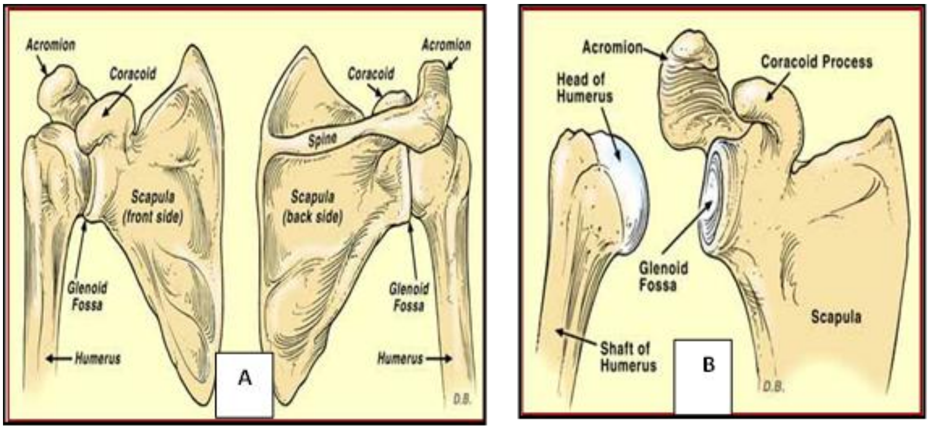


Figure (1): Bones forming shoulder joint ***(Quoted from Stoller, 1997).***

The lateral angle of the scapula is thick and strong, with an expanded large, shallow glenoid fossa, facing slightly forward and upwards, ready to receive the head of the humerus. Just medial to the glenoid fossa is the coracoid process as it projects upwards from the neck of the scapula.

The coracoid process serves as an attachment site for several important ligaments and muscles ***(Goldstein, 2004).***

The acromion classified into three types according to its morphology:

A- **Type 1:** flat or straight undersurface with high angle of inclination.

B- **Type 2:** curved arc and decreased angle of inclination.

C- **Type 3:** hooked anteriorly with decreased angle of inclination.

(Stoller, 1997)

The proximal humerus consists of the head, anatomic neck, and the greater and lesser tuberosities. The intertubercular or bicipital groove is located between the greater and lesser tuberosities along the anterior surface of the humerus ***(Stoller, 1997).***

The head of the humerus is approximately one third of a sphere and it is about four times larger than the socket on the scapula. In anatomic position, it faces superiorly, medially, and posteriorly with the lesser tuberosity in front and the greater tuberosity pointing laterally ***(Goldstein, 2004)*** **(Fig. 2).**

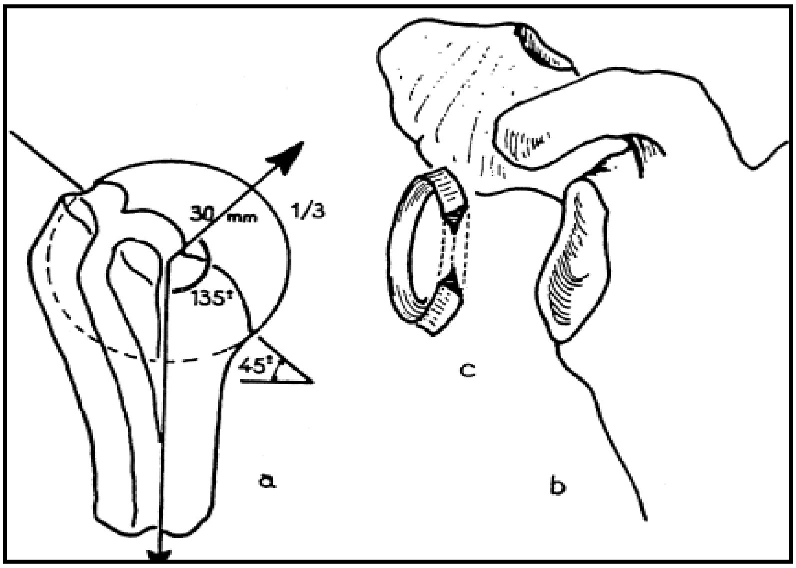


Figure (2): The head of the humerus faces superiorly, medially& posteriorly. It corresponds to a third of a sphere 3 cm in radius. Its axis forms with the axis of the shaft an angle of 135^{o} & with the frontal plane an angle of 30^{o}. The anatomic neck makes an angle of 45^{o}with the horizontal plane. The glenoid cavity of the scapula lies at the superolateral angle of the scapula & points laterally, anteriorly and slightly superiorly. The glenoid cavity is much smaller than the head of the humerus but deepened by a ring of fibro-cartilage, the glenoid labrum ***(Quoted from Goldstein, 2004)***

B-Muscles of the Shoulder Joint

1- Deltoid Muscle

The largest and the most important of the glenohumeral muscles is the deltoid muscle ***(Williams and Dyson, 2000).***

It consists of three parts, the anterior deltoid, the middle portion and the posterior deltoid. Elevation in the subscapularis plane is the role of the anterior and middle portions with some actions by the posterior parts especially above 90 degrees ***(Williams and Dyson 2000).***

Flexion is the role of the anterior and middle parts of the muscle and the clavicular portions of the pectoralis major, with some contributions by the biceps. Abduction in the coronal plane is mainly by the action of the posterior portion of the muscle ***(Williams and Dyson 2000).***

2- Rotator cuff muscles (Figs. 3,4&5)

The rotator cuff is generally defined as a complex of four muscles that arise from the scapula and attach to the tuberosities of the humerus along with the adjacent capsule that blends with these tendons near their insertions. The muscles of the rotator cuff include the subscapularis, supraspinatus, infraspinatus and teres minor muscles arranged in the sagittal image as well as in the corresponding projectional image in figures ***(Williams and Dyson, 2000).***

A- The supraspinatus muscle (SST) (Figs. 3,4&5)

The supraspinatus muscle arises from the medial two thirds of the supraspinatus fossa of the scapula and from the strong supraspinatus fascia. The muscle forms a tendon, which passes under the acromion and inserts in the highest facet in the greater tuberosity of the humerus as it approaches its insertion, many fibers are fused with the capsule of the shoulder joint. Its tendinious insertion is in common posteriorly, with the infraspinatus tendon and anteriorly, with the coraco-humeral ligaments ***(Williams and Dyson, 2000).***

B- The Infraspinatus Muscle (Figs. 3,4&5)

The infraspinatus arises from the medial two thirds of the infraspinatus fossa. The tendon of the muscle inserts in the middle facet of the greater tuberosity of the humerus ***(Hodler et al., 1992).***

As it crosses the capsule of the shoulder joint some of the fibers blend with the capsule. The tendon is in common anteroposteriorly with the supraspinatus tendon and inferiorly with the teres minor tendon ***(Hodler et al., 1992).***

C- The Subscapularis Muscle (Figs. 3,4,5&6)

It is the anterior portion of the rotator cuff. It arises from the subscapularis fossa ***(Hodler et al., 1992).***

It is a large powerful muscle that inserts in the lesser tubercle of the humerus, some fibres blend with the capsule of the shoulder joint, some fibres are sometimes found passing in the inter-tubercular sulcus ***(Hodler et al., 1992).***

D- Teres Minor Muscle (Figs. 3,4,5&6)

The teres minor muscle is a narrow muscle which arises from a strip along the upper two thirds of the lateral edge on the dorsal surface of the scapula. It is sometimes inseparable from the infraspinatus. Its tendon inserts in the lowest facet on the greater tuberosity of the humerus ***(Hodler et al., 1992).***

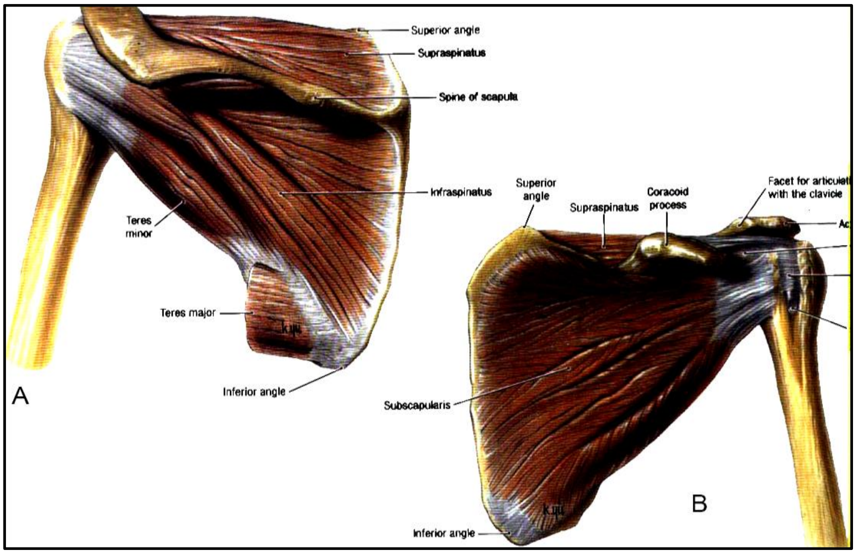


Figure (3): Graphic image of a coronal section **A**-posterior view **B**-anterior view of the rotator cuff muscles ***(Quoted from Williams & Dyson 2000).***

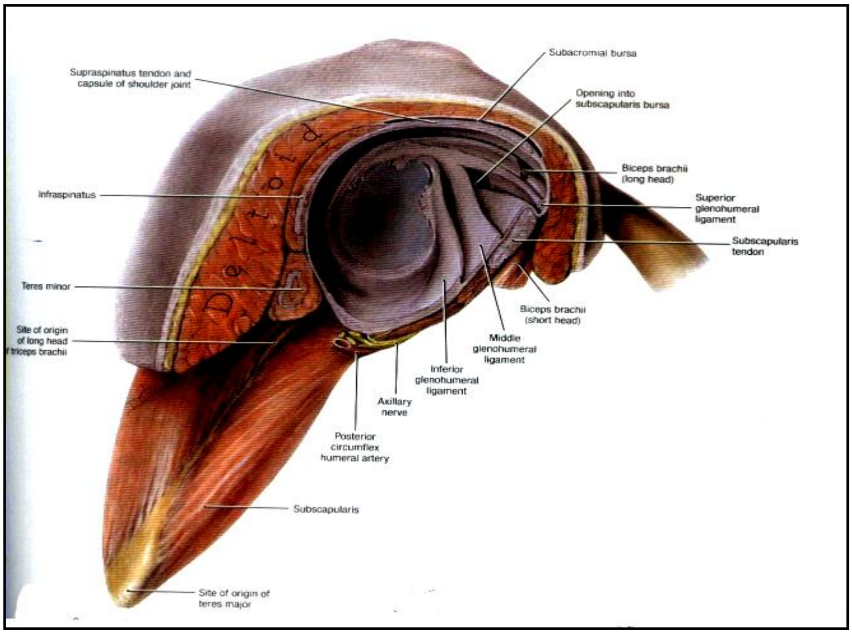


Figure (4): Graphic image of a lateral section through the shoulder showing the glenohumeral ligaments as well as the rotator cuff superimposed by the deltoid muscle ***(Quoted from Williams & Dyson 2000).***

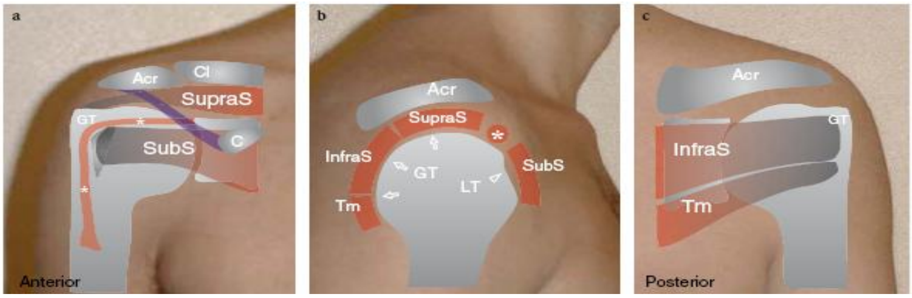
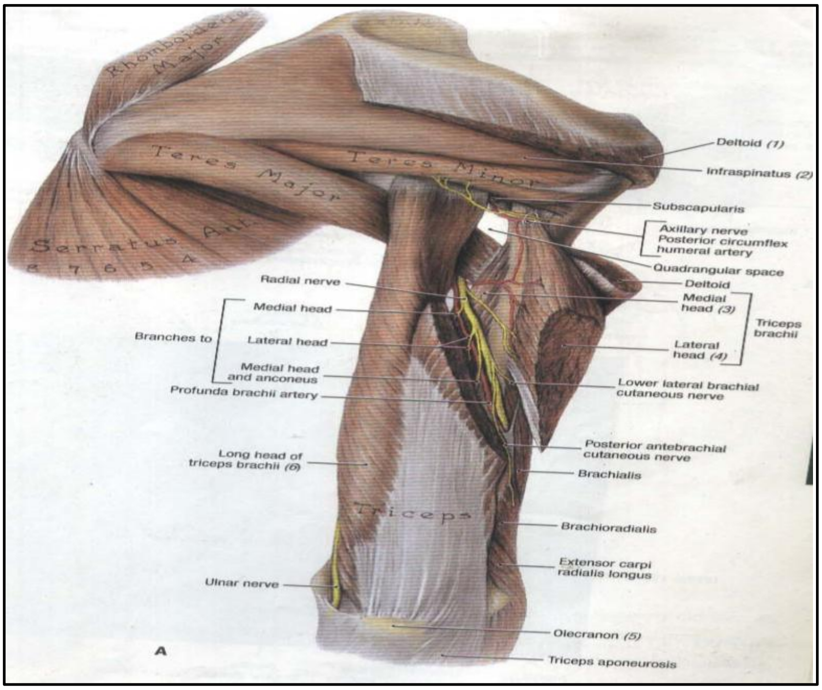
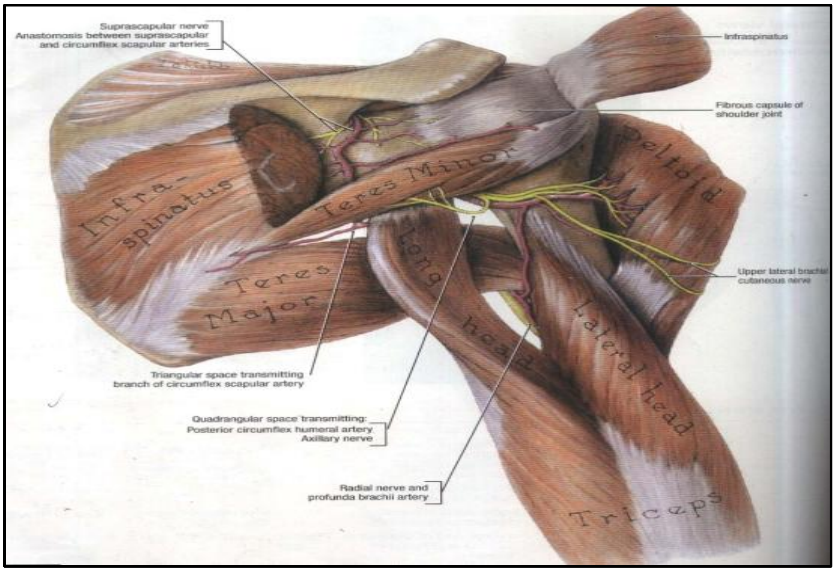


Figure (5): **a–c.** Projectional images of rotator cuff muscles and tendons as seen in an anterior **(a)**, lateral **(b)** and posterior **(c)** view of the shoulder. Note the relationship of the supraspinatus *(SupraS),* subscapularis *(SubS),* infraspinatus *(InfraS),* teres minor *(Tm)* and long head of the biceps tendon *(asterisk)* with the main palpable bony landmarks of the shoulder, including the acromion *(Ac),* the clavicle *(Cl),* the greater tuberosity *(GT),* the lesser tuberosity *(LT)* and the coracoid process *(Co).* The coracoacromial ligament is shown as a *blue strip* covering the biceps and the supraspinatus ***(Quoted from Michener et al., 2003).***



A)



B)

Figure (6): **A** & **B** graphic images of a posterior view of the dorsal scapular and subdeltoid region muscles with attrition of the infraspinatus tendon and intact teres minor muscle in **B** image while both are intact in **A** image note the fan shaped appearance of the serratus anterior muscle ***(Quoted from Williams & Dyson 2000).***

C-Joints of the shoulder girdle

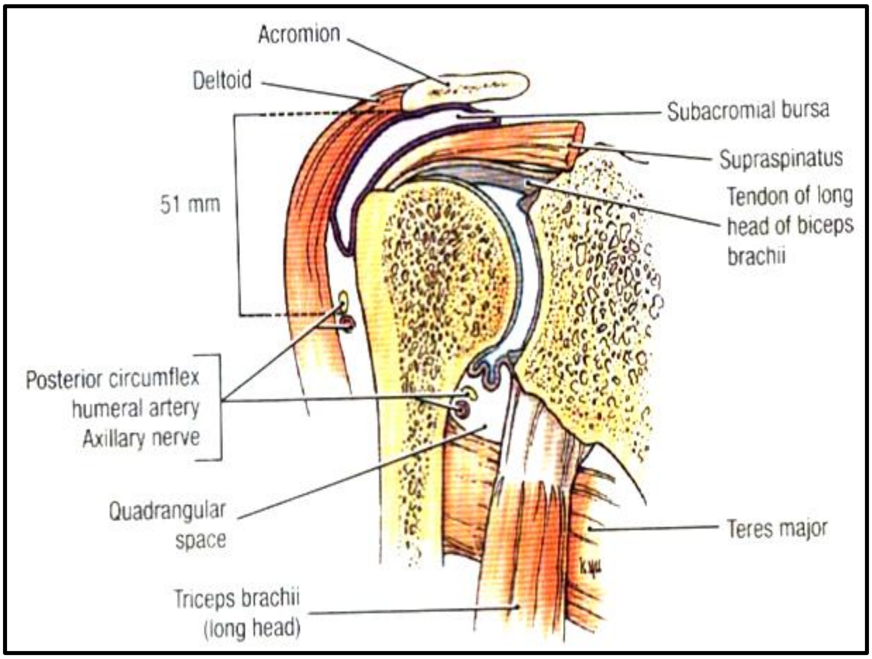
I-Glenohumeral joint

The great freedom of movement of the glenohumeral joint is inevitably accompanied by a considerable loss of stability. To compensate for this, the joint is reinforced by the tendons of the rotator cuff. In addition, the joint capsule has a rather complex structure consisting of the labrum and the glenohumeral ligaments, known as the labral capsular complex that further aids stability ***(Sarrafian, 2000)*** **(Fig.7)**

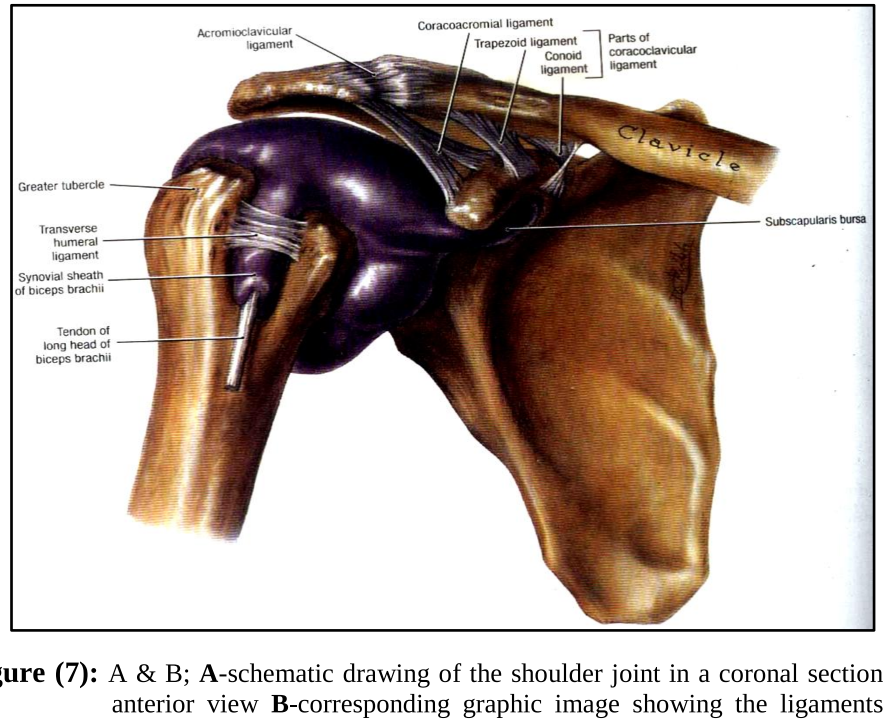
As the convexity of the humerus is much larger than the glenoid cavity, only a minor part of it can be in contact with the cavity in any given position of the joint and the remainder of its articular surface is in contact with the inner aspect of the capsule ***(Peterslilge el al, 2001).***

Both articular surfaces are covered with a layer of hyaline cartilage that on the head of the humerus is thickest at its centre and thinner peripherally, with the reverse is the case in the glenoid cavity. However, in most positions of the joint, the curvature of the adjacent parts of the surfaces are not precisely the same i.e. they are not congruent and the joint is loosely packed ***(Peterslilge et al., 2001).***

Full congruence and close packed position is reached when the humerus is abducted and laterally rotated. The glenoid cavity is deepened somewhat by a fibro-cartilaginous rim attached to its margins, the glenoid labrum ***(Peterslilge et al., 2001).***



A)



B)

Figure (7): A & B; **A**-schematic drawing of the shoulder joint in a coronal section anterior view **B**-corresponding graphic image showing the ligaments and the synovial envelope of the joint capsule ***(Quoted from Williams & Dyson 2000).***