Dynamic Ultrasonography and MRI: Comparative Study in Evaluation of Shoulder Impingement Syndrome

Thesis

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By

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Abstract

This study included ٥٠ patients with shoulder impingement. For every patient; Dynamic Ultrasonography and MRI were done , with diagnostic arthroscopy was done for ١٠ cases. The preliminary results have shown the great role of dynamic ultrasonography in the diagnosis of shoulder impingement, with high sensitivity and specificity, as compared to MRI and diagnostic arthroscopy.

(Key Words: dynamic ultrasonography-MRI-shoulder impingement)

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Introduction and Aim of Work

The basis of the shoulder impingement syndrome is the restricted space that exists between the coracohumeral arch above and the humeral head and tuberosities below. Through this space pass the tendons of the rotator cuff **(Nathalie. et al ٢٠٠٦).**

Subacromial impingement syrdrome is a clinical entity that was proposed by **Neer in ١٩٧٢**. This syndrome is a result of chronic irritation of the supraspinatus tendon against the undersurface of the anterior third of the acromion, the coraco-acromial ligament and the acromio-clavicular joint, it is often difficult to diagnose because the clinical presentation may be confusing and clinical tests lack specificity **(Bigliani and Levine, ١٩٩٧).**

MRI was considered to be a reliable technique for the evaluation of the rotator cuff tendons, but it provides a static evaluation of the shoulder joint. It can only indirectly suggest the diagnosis of subacromial impingement, because most findings are nonspecific **(Nathalie et al., ٢٠٠٦).**

Studies have investigated the value of dynamic MR evaluation of the shoulder with open MRI. The major limiting factors of dynamic MRI are the restricted availability of open magnets and the fact that the MR technology only allows sequential imaging of single-plane shoulder motions that don't entirely reproduce physiologic shoulder motion **(Nathalie et al, ٢٠٠٦).**

Large number of factors could cause shoulder impingement syndrome. They are divided into two major groups: structural factors (related to the acromion, acromioclavicular joint, coracoid process, bursa, humerus and rotator cuff) and functional factors **(Ditsosis K. et al., ٢٠٠٢).**

Pathogenesis of shoulder impingement: with the arm in a neutral position, the supraspinatus tendon and tendon of the long head of the biceps brachii muscle lie anterior to the acromion, acromio-clavicular joint and caraco-acromial ligament. With forward flexion of the arm, the supraspinatus tendon, greater humeral tuberosity and tendon of long head of the biceps brachii muscle become more intimate and in direct contact with the acromion, acromio-clavicular joint and coraco-acromial ligament **(Bigliani and Levine, ١٩٩٧).**

Being an available, widely spread, fast and non invasive technique for the assessment of musculoskeletal disorders including evaluation of the shoulder joint. High-resolution ultrasonography has gained increasing popularity as a diagnostic tool for musculo-skeletal assessment**(Melanie et al., ٢٠٠٥)**.

Technical developments and improvements, increased experience, detailed knowledge of shoulder anatomy and pathologic conditions, awareness of different Sonographic pitfalls, Limitations and artifacts have significantly improved the Sonographic results in shoulder assessment **(Mathieu et al ٢٠٠٦).**

Aim of Work

The purpose of this study is to evaluate and compare the role of dynamic high resolution ultrasonography and MR imaging in the detection of abnormalities of subacromial impingement and to find out the value added by dynamic ultrasonography to the static examination of such cases, using MR imaging as a gold standard.

In the developing countries, the cost/ effectiveness is a very important issue in the evaluation of any diagnostic examination, so we have a goal to offer an accurate and highly sensitive diagnostic method for the cases of shoulder impingement, being widely spread and of low cost.

Bones of the shoulder joint

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 sternoclavicular joint. The lateral one-third is flat, and its sternal end is expanded as it curves back to meet the scapula at the acromioclavicular joint **(De Palma et al, ١٩٩٩**)

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 scapulothoracic interface). 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 **(De palma et al, ١٩٩٩**)

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 **(De palma et al, ١٩٩٩**)

The acromion classified into three types according to its morphology:

A-Type ١: flat or straight undersurface with high angle of inclination.

B-Type ٢: curved arc and decreased angle of inclination.

C-Type ٣: hooked anteriorly with decreased angle of inclination **(Stoller et al, ١٩٩٧- Prescher, ٢٠٠٠).**

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**.** 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 **(Stoller, et al, ١٩٩٧)**

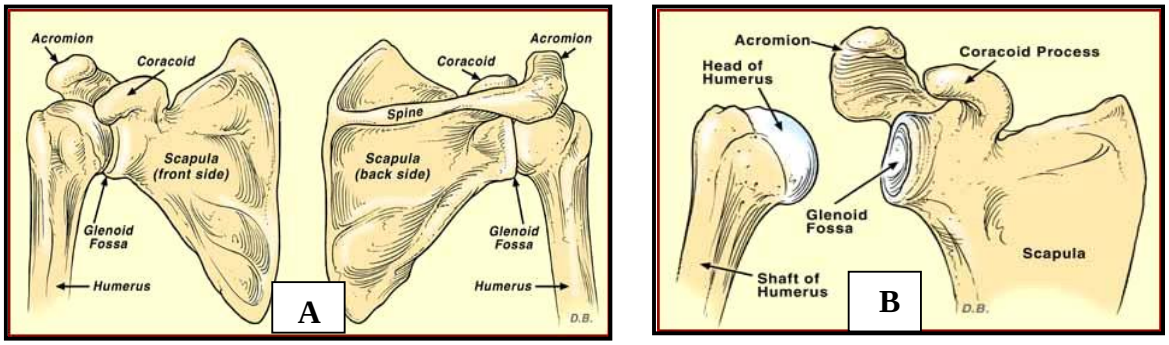


Fig.١ A& B Bones forming shoulder joint **(** Stoller ١٩٩٧)

Joints of the shoulder girdle

I-Glenohumoral joint

The glenohumeral joint is a multi axial spheroid joint. The bones involved are the roughly hemispherical head of the humerus and the shallow glenoid cavity of the scapula, a construction, which permits a very considerable range of movements but reduces the security of the joint **(Inman, ١٩٩٤).**

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, ١٩٨٣)**

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. Both articular surfaces are covered with a layer of hyaline cartilage that on the head of the humerus is thickest at its center 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. Full congruence and close packed position is reached when the humerus is abducted and laterally rotated. The glenoid cavity is deepened somewhat by a fibrocatilagenous rim attached to its margins, the glenoid labrum **(Peterslilge el al, ١٩٩٧).**

The Glenoid labrum

It is the fibrous attachment of the glenohumeral ligaments and capsule to the glenoid rim around the margin of the glenoid cavity. It is triangular in section, the base being fixed to the circumference of the cavity, while the free edge is thin and sharp. Measuring about ٦mm in width and ٣mm in height, the labrum is somewhat shallower on the sides of the cavity. It deepens the articular cavity and protects the edges of the bone. It increases the surface of articulation with humeral head and serves as anchoring mechanism distributor of stress forces for the capsular attachment rather

than as a static restraint for the physiologic alignment of the humeral head with the glenoid fossa **(Mulligian et al, ٢٠٠٥).**

The anterior labrum provides the major area of attachment for the anterior band of the inferior glenohumeral ligament. The middle glenohumeral ligament is considerably more variable, but also may contribute fibers to the more superior aspects of the anterior glenoid labrum as it approaches the biceps tendon (**Mulligian et al, ٢٠٠٥**).

The superior labrum does have a role in the stability of the glenohumeral joint and functions in conjunction with the biceps tendon, with which it is contiguous (the biceps labral complex.

Inferior to the epiphyseal line (the junction of the upper and middle thirds of the glenoid body fossa), the labrum is continuous with the glenoid articular cartilage and serves as the insertion site for the inferior glenohumeral ligament **(Mulligian et al, ٢٠٠٥)**.

The articular capsule

The capsule of the joint is thick and strong but lax, especially inferiorly, to allow great range of movement. It is attached to the humerus around the articular margins of the head except inferiorly, where it is attached to the surgical neck, enclosing a portion of the epiphyseal line. It completely encases the joint, being attached medially to the circumference of the glenoid cavity beyond the glenoidal labrum, reaching the neck of the scapula, as far as the root of the coracoid process. With the arm hanging loosely at the side, there is a loose recess inferiorly, sometimes called axillary fold to allow space for the head of the humerus during full abduction. Thickening of the anterior capsule are named (superior, middle, inferior glenohumeral ligaments) **.**

The capsule is reinforced, **above**; by the supraspinatous; **below** by the long head of the triceps; **behind** by the tendon of the infraspinatous and teres minor; and **in front** by the tendon of the subscapularis.

In the passage of the tendons of the subscapularis, infraspinatous, supraspinatous, and teres minor over the fibrous capsule to their insertions on the tubercles of the humerus, they blend together with the capsule to form a musculotendinous or rotator cuff.

The posterior capsule includes the capsule posterior to the biceps tendon and superior to the posterior band of the IGL. This represents the thinnest portion of the capsule. The posterior capsule has a role in limiting both the posterior and anterior translation of the glenohumeral joint. With an intact anterior capsule, posterior dislocation does not occur even with the division of the posterior capsule **(Yeh et al, ١٩٩٨).**

The arteries supplying the joint. Are derived from the anterior and posterior circumflex humeral and suprascapular arteries **(Williams& Dyson, ١٩٩٢)**

The nerves of the joint.

Are derived mainly from the posterior cord & from the suprascapular, axillary &pectoral nerves **(Williams& Dyson, ١٩٩٢**).

The muscles related to the joint

Are, **superiorly,** supraspinatus, **inferiorly,** the long head of triceps, **anteriorly,** subscapularis, **posteriorly,** infraspinatus &teres minor, **within,** the tendon of long head of biceps. Deltoid covers the joint in front, behind, and laterally **(Williams& Dyson, ١٩٩٢).**

Ligaments related to the humeral joint

(١)The glenohumeral ligaments

The joint capsule is thickened anteriorly to form separate components known as glenohumeral ligaments, which act to re-enforce the capsule. At their scapular end they are all attached to the upper part of the medial margin of the glenoid cavity and are blended with the glenoid labrum. The superior band passes along the medial edge of the biceps tendon and is attached to a small depression above the lesser tubercle of the humerus.

The middle band reaches to the lower part of the lesser tubercle. The Inferior band extends to the lower part of the anatomical neck of the humerus **(Williams& Dyson, ١٩٩٢).**

(٢)The transverse humeral ligament

Extends from the lesser to the greater tuberosity of the humerus, it converts the intertubercular sulcus into a canal; it acts as a retinaculum for the biceps tendon **(Williams& Dyson, ١٩٩٢).**

(٣) **The coracohumeral ligament**

Broad band strengthening the upper part of the capsule, it is attached to the lateral border of the coracoid process, and passes obliquely downwards & laterally to the front of the humerus, blending with the tendon of supraspinatus **(Williams& Dyson, ١٩٩٢)**

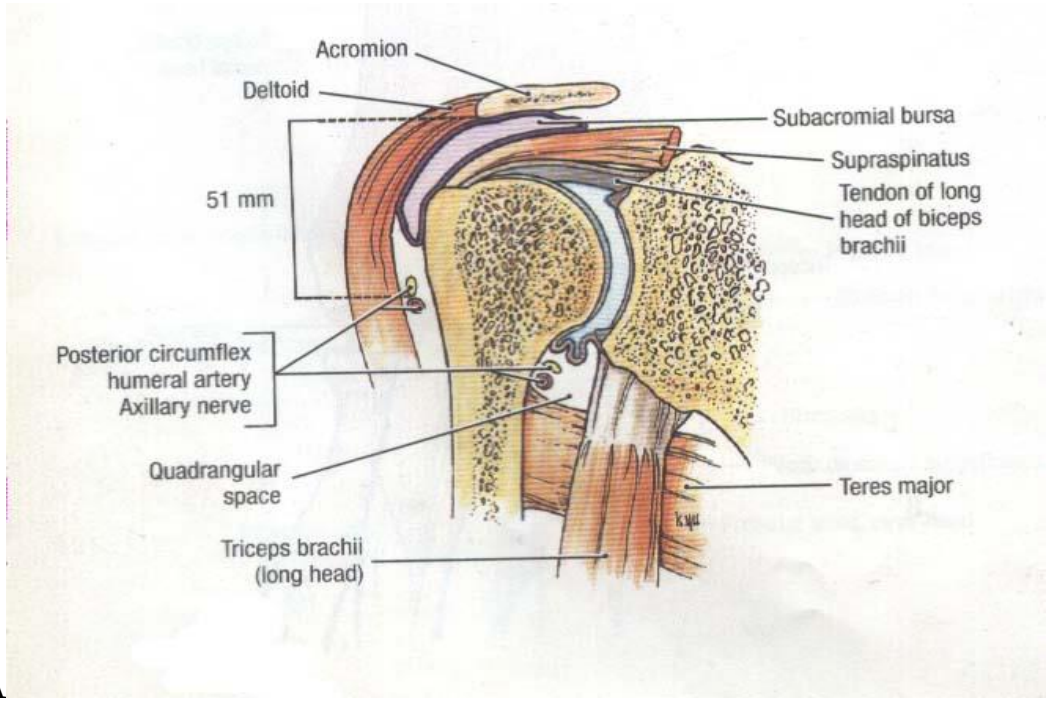
A 

Fig. (٢): A-schematic drawing of the shoulder joint in a coronal section anterior view, showing the ligaments and the synovial envelope of the joint capsule (Williams& Dyson, ١٩٩٢) .

II- Acromioclavicular joint

A fibrous disk separates the surfaces of the distal end of the clavicle and the acromion (Salter et al, ١٩٨٧}. There is a small amount of movement at the acromio clavicular joint and compressive force is applied to the joint in full elevation and horizontal adduction which is the bases of stress tests applied to this joint. The joint is stabilized by deltoid and trapezius muscles that act to provide some anterior and superior stability and of particular importance is the coracoclavicular ligament which maintains close relationship between the scapula & the clavicle during shoulder movements **(De Palma, ١٩٩٩).**

III-Sternoclavicular joint

The sterno-clavicular joint is composed of the upper end of the sternum and the proximal end of the clavicle .It is the only skeletal articulation between the upper limb and the skeleton. Like the acromio clavicular joint. The sterno-clavicular joint contains an intra articular fibrous disk that allows rotation of the clavicle during abduction &elevation. Strong ligaments stabilize this joint anteriorly and posteriorly ***(Jobe, ١٩٩٠).***

Bursae related to the shoulder.

A-Subscapular bursa

It is found constantly between the tendon of the subscapularis tendon and the underlying joint capsule. It usually communicates with the synovial cavity through an opening between the superior and middle glenohumeral ligaments in the anterior part of the capsule.

B- Subdeltoid bursa

It is a large bursa between the deep surface of the deltoid muscle and the joint capsule, over the upper and lateral aspect of the humerus. It does not communicate with the synovial cavity.

C- Subacromial bursa

It lies between the deep surface of the acromion and the tendon of the supraspinatous tendon overlying the joint capsule. It usually extends under the coracoacromial ligament and frequently is continuous with the Subdeltoid bursa.

D- Subcoracoid bursa

May lie between the coracoid process and the capsule, or it may be an extension from the Subacromial bursa.

E- others as coracobrachialis bursa, infraspinatous bursa, and subcutaneous acromial bursa. (Stoller et al, ١٩٩٧)

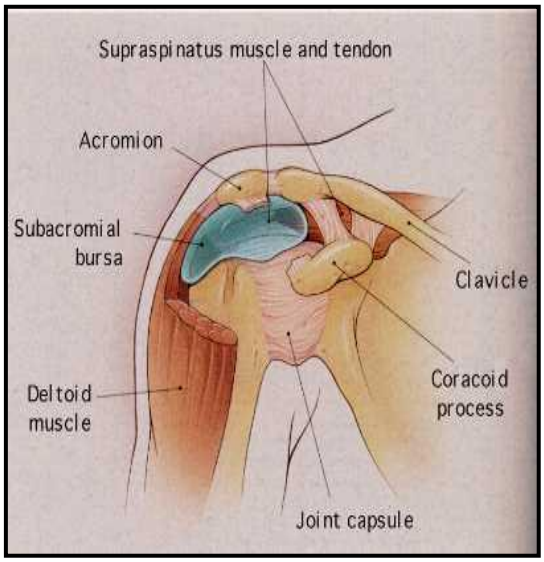


Fig.٣a: Subacromial bursa
(Williams& Dyson, ١٩٩٢)

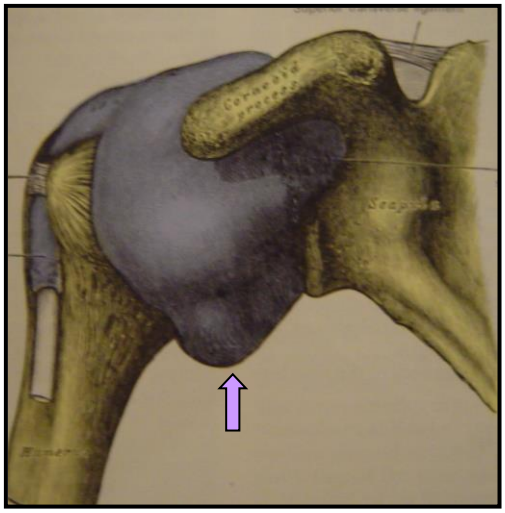


Fig. ٣b: Subscapular bursa
(Williams& Dyson, ١٩٩٢)

Coracoacromial arch

The coracoacromial arch is comprised of the under surface of the anterior third of the acromion, the coracoacromial ligament, the anterior third of the coracoid process, the acromio clavicular joint, and the distal clavicle (**Tirman et al, ١٩٩٧).**

It serves as an attachment site for many muscles and tendons that affect the function of the shoulder joint. It limits the space available to the rotator cuff tendons physiologically during abduction and serves as a mechanical restrain for the humeral head **(Parley et al, ١٩٩٤).**

Coracoacromial ligament is the key structure of the coracoacromial