ABSTRACT

Glenohumoral joint is the most mobile joint in the body and shoulder instability is one of the major problems in musculo-skeletal diseases.

MR imaging and MR arthrography are useful for optimal delination of capsulo-labral structures, rotator cuff muscles and tendons defects in patients with recurrent shoulder instability.

Key Words: Glenohumoral Joint, Recurrent Shoulder Instability, Musculo-Skeletal Diseases, MR Imaging and MR Arthrography.

INTRODUCTION

The shoulder joint (also called the glenohumeral joint) has the largest range of motion of all joints in the human body. The joint capsule, ligaments, and muscles help to resolve the incongruity between the humeral head and the glenoid cavity, therefore the shoulder joint is prone to dislocation. **(Mutlu et al., 2013)**.

Shoulder instability is a common clinical problem, especially in young active individuals. Glenohumeral instability can be classified in many ways, for example, (a) according to degree (subluxation vs. dislocation), (b) acute vs. recurrent, (c) with respect to direction, i.e., unidirectional (when it may be anterior, posterior, or inferior) or multidirectional **(Jana et al., 2011).** (d) According to etiology, i.e., traumatic or atraumatic. **(Sherbondy and McFarland, 2000)**.

The recurrence of glenohumeral joint instability occurs as a result of changes in bones, cartilages, and soft tissues. **(Liu and Henry, 1996).**

The rate of recurrence in later years is at least 70%. As many as 95% of shoulder dislocations are anterior. Anterior dislocations often lead to recurrent anterior glenohumeral instability. Recurrent anterior glenohumeral instability accounts for the largest portion of the shoulder laxity spectrum . **(Dodson and Cordasco, 2008).**

Musculoskeletal (MSK) imaging is an important diagnostic and teaching tool for the spectrum of healthcare providers who treat MSK problems. Magnetic resonance imaging (MRI) provides an effective investigation for assessing the shoulder joint with excellent resolution, soft tissues contrast and the ability to take images in multiple planes **(Tirman et al., 1997)**. This has made MRI a primary imaging technology for detecting the changes in the soft tissues, such as ligaments and tendons tears, and in bone injuries. **(Deyle, 2011).**

Magnetic resonance arthrography (MRA) provides additional benefit by utilizing the benefits of contrast enhancement (increasing the capacity to observe intraarticular anatomy and pathology) .**(Lee and Lang, 2000).**

AIM OF THE WORK

The aim of the study is to:

- Investigate the usefulness of MRI in assessing capsular laxity in patients with recurrent shoulder instability.

ANATOMY OF THE SHOULDER

The anatomy of the shoulder joint is unique , it has a relatively shallow socket which results in amazing flexibility and range of motion to the shoulder joint which is unparalleled elsewhere in the body. In order to achieve this flexibility but maintain a stable shoulder, there is a complex interplay between the joint, muscles and ligaments. Injury to any one of these structures can therefore result in significant ongoing pain, weakness, or instability.

The shoulder is actually made up of two separate joints , the glenohumeral and acromioclavicular joints. These two joints work together to allow the arm both to circumduct in a large circle and to rotate around its axis at the shoulder.

The glenohumeral joint is a ball and socket joint formed between the articulation of the rounded head of the humerus (the upper arm bone) and the cup-like depression of the scapula, called the glenoid fossa.

Bony anatomy of the shoulder:

The clavicle (commonly known as the **collar bone**) is an S-shaped bone that forms the sternoclavicular joint medially and the acromioclavicular joint laterally. Its morphology is extremely variable, ranging from flat to sharply curved. Increased thickness and curvature is seen in manual workers, and the right clavicle is often stronger than the left. **(Cook et al., 2011).**

The scapula is composed of a spine, neck, and body, as well as the acromion, coracoid process, and glenoid. The latter three structures form articulations with the humeral head and the clavicle to become components of the shoulder joint. The acromion is a posterior shoulder landmark, formed as a posterolateral extension of the scapular spine, superior to the glenoid. It articulates with the clavicle and is the origin of the deltoid and trapezius muscles. The shape of the acromion is symmetric bilaterally but can vary with gender. Bigliani and colleagues' classification system for acromial morphology offers three types: I (flat), II (curved), and III (hooked). It is hypothesized that the hooked acromion is in fact an acquired form and increases an individual's predisposition to rotator cuff pathology. **(Cook et al., 2011).**

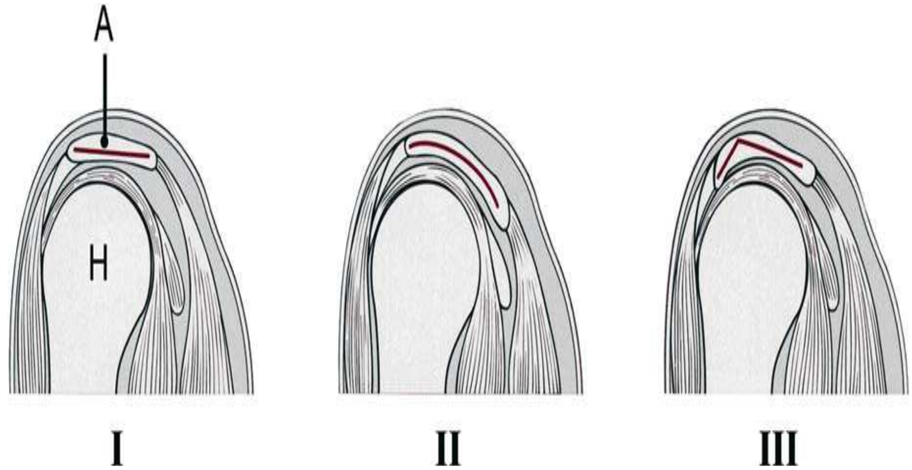

Figure (1): Schematic drawing of most common anterolateral acromion types. Type I: fl at undersurface, type II: smoothly curved undersurface, type III: anteriorly hooked acromion (*A*, acromion, *H*, humerus). (Van der Woude et al., 2007).

The coracoid process is an anterior shoulder landmark, arising from the anterolateral aspect of the scapula, superior and medial to the glenoid fossa. It also represents the tendinous origins of a number of upper extremity and chest wall muscles, including the pectoralis minor and long head of the biceps brachii. The morphology of the coracoid is extremely variable. The glenoid articulates with the medial aspect of the humeral head to form the shoulder joint. The glenoid is pear shaped (also known as inverted-comma shaped) or oval shaped in the coronal plane and does not vary appreciably in size between men and women; significant differences in glenoid morphology have been found among different ethnicities. The glenoid cavity is retroverted by approximately 5°to 7°. The postero-inferior rim of the glenoid can have various shapes, including triangular, J shaped, and deltoid. The latter two are associated with varying degrees of posterior shoulder instability as is loss of tilting and concavity of the inferior glenoid. At the superior aspect of the glenoid, the supra-glenoid tubercle serves as the attachment for the long head of the biceps. **(Cook et al., 2011).**

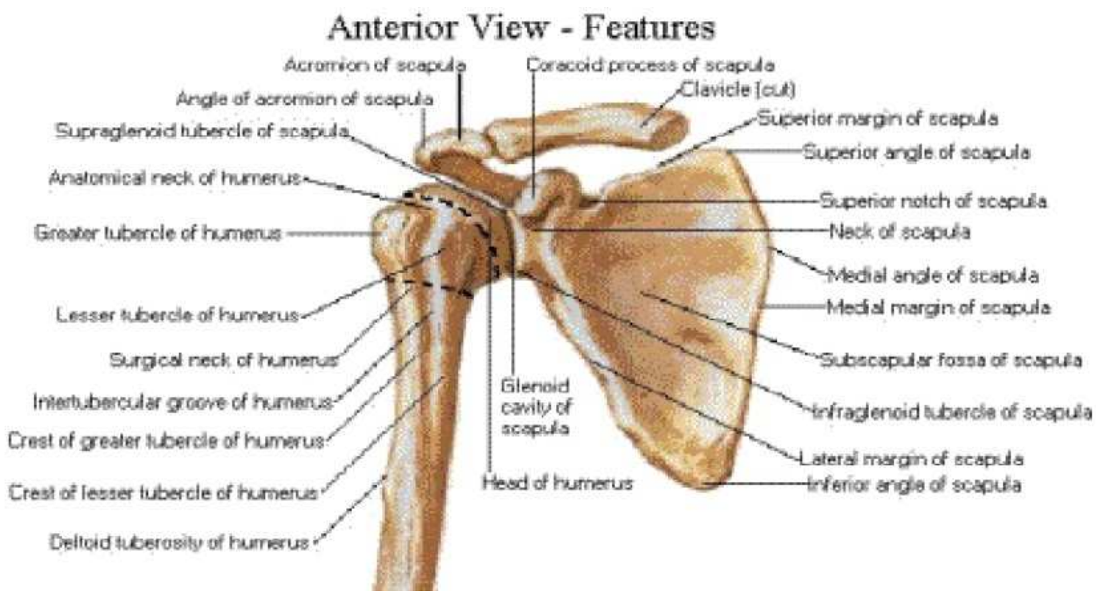

Figure (2): Bony anatomy of the shoulder joint (Netter, 2010).

The humerus: The proximal humerus consists of the humeral head, the greater and lesser tuberosities, the humeral neck, and the bicipital groove. The humeral head makes the most significant contribution to the shoulder. It is typically round, with slight flattening of the posteroinferior surface. This slight flattening should not be confused with a Hill-Sachs lesion as a sequela of anterior shoulder dislocation, which is seen at/ or above the level of the coracoid process. The central portion of the humeral head is spherical, whereas the peripheral contour is more elliptical. The morphology of the humeral head varies somewhat between men and women, particularly with respect to the radius of curvature, which is larger in men than women. Distinction is commonly made between the anatomic and the surgical necks of the humerus. The anatomic neck forms the oblique circumference of the humeral head and separates the head from the tuberosities. The surgical neck forms the axial circumference of the humerus immediately inferior to the tuberosities and is often involved in fractures. The cartilage overlying the humeral head is only approximately 1 mm thick. The bicipital groove, also known as intertubercular groove, runs between the greater and lesser tuberosities and supports the long head of thebiceps tendon. The transverse humeral ligament crosses the long head of the biceps tendon perpendicular to the bicipital groove. The width and depth of the groove both affect the risk of subluxation of the long head of the biceps tendon. A shallow bicipital groove predisposes to dislocation of the long head of the biceps tendon.**(Cook et al., 2011).**

Shoulder ligaments, labrum, bursae and the joint capsule:

Glenoid labrum :

The glenoid labrum is the fibrous attachment of the glenohumeral ligaments and capsule to the glenoid rim (figure 3). The normal glenoid labrum is 3mm high and 4 mm wide, but its size, shape, and configuration vary considerably.

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

The superior labrum does have a role in the stability of the glenohumeral joint and functions in conjunction with the bicepstendon, with which it is contiguous (the biceps labral complex [BLC]). **(Beltran et al., 1997).**

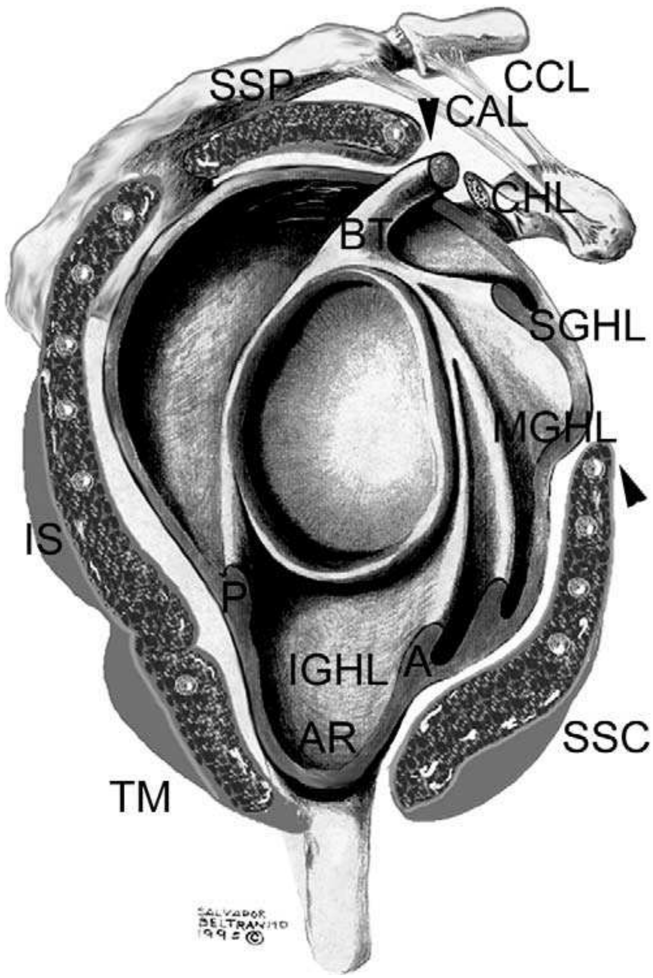

Figure (3): Schematic rendering of the glenoid fossa, capsuloligamentous structures, rotator cuff, and scapula. SSP, supraspinatus muscle and tendon; SSC, subscapularis muscle and tendon; IS, infraspinatus muscle and tendon; TM, teres minor muscle and tendon; BT, intracapsular long bicipital tendon and tendon anchor; SGHL, superior glenohumeral ligament; MGHL, middle glenohumeral ligament; IGHL, inferior glenohumeral ligament; A, anterior band of the IGHL; P, posterior band of the IGHL; AR, axillary recess; CCL, coracoclavicular ligament; CAL, coracoacromial ligament; CHL, coracohumeral ligament. The space between the anterior margin of the SSP and the superior margin of the SSC is the rotator cuff interval (between the two arrowheads). The joint capsule, BT, SGHL, and CHL, occupies this space. (Beltran and Kim, 2003).

There are three different types of attachment of the biceps labral complex (BLC) to the glenoid (figure 4):

Type 1: BLC is firmly adherent to the superior pole of the glenoid (see figure 4A). There is no sublabral foramen in the anterosuperior quadrant.

Type 2: BLC is attached several millimeters medial to the sagittal plane of the glenoid (see fig. 4B). The superior pole of the glenoid continues with its hyaline cartilage surface medially, under the labrum. This configuration has a small sulcus at the superior pole of the glenoid that may be continuous with a sublabral foramen and communicate with the subscapularis bursa.

Type 3: in type 3 BLC the labrum is very meniscoid in shape (see fig. 4C) and has a large sulcus that projects under the labrum and over the cartilaginous pole of the glenoid **(Tirman et al., 2002)**.

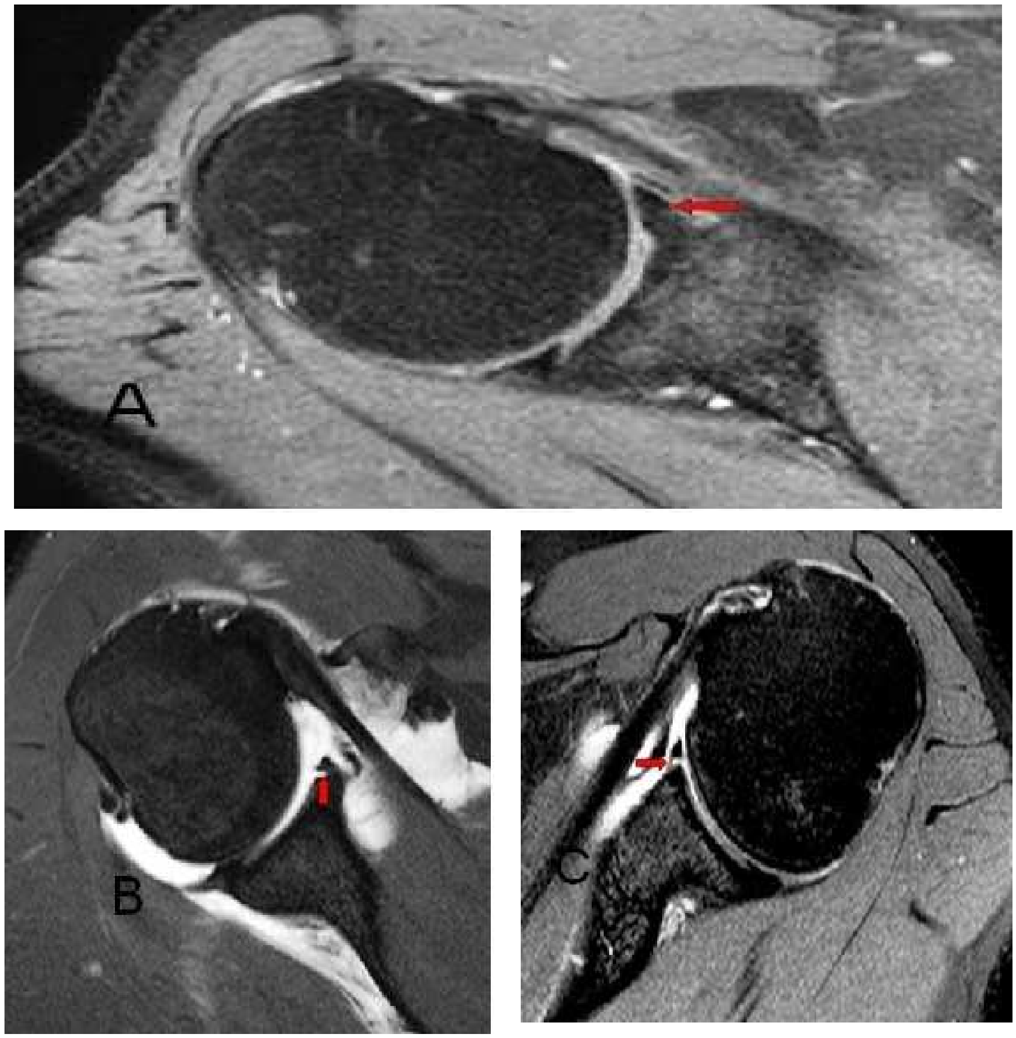

Figure (4): A:Axial MR -T2 SPAIR fat suppressed sequence showing a type 1 bicipitolabral complex. B: Axial MR -T2 SPAIR fat suppressed sequence showing a type 2 bicipitolabral complex with partial peripheral detachment. C: Axial MR -T2 SPAIR fat suppressed sequence showing a type 3 bicipitolabral complex with a complete sublabral foramen. (Chatterjee and Sureka, 2009).

The articular capsule :

The joint capsule attaches laterally on the anatomic neck of the humerus. Medially, the capsule usually attaches to the labrum or to the adjacent periosteum of the glenoid.

Three types of anterior capsular insertions have been described:

Type I consists of a medial attachment on or very near the labrum, type II insertion is found within 1 cm medial to the labrum, and type III capsular attachment is more than 1 cm medial to the labrum.

- It is believed that type III anterior capsular insertion may either predispose to instability or represent the sequelae of a previous dislocation with stripping of the anterior capsule and periosteum off the glenoid. This belief is not widely acknowledged. The posterior capsule attaches directly on the posterior glenoid labrum . **(Helms et al., 2009).**

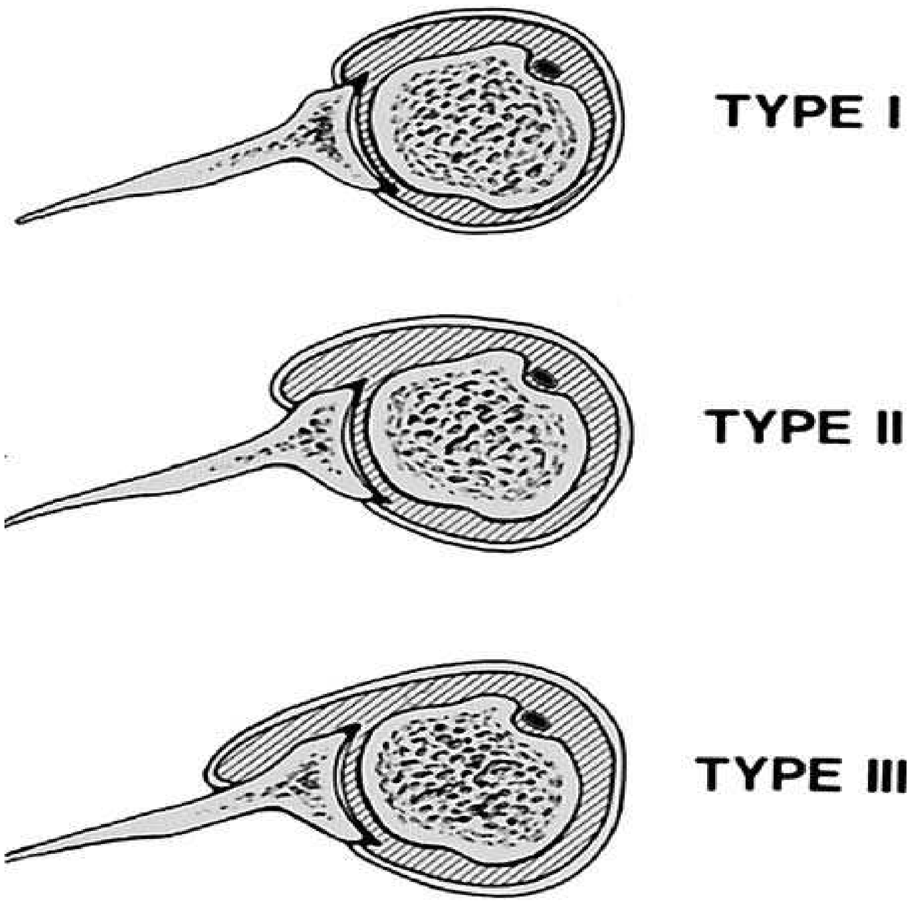

Figure (5): Types of anterior capsular insertion. Type III, the more medial insertion is prone to anterior glenohumeral instability. (Beltran and Suhardja, 2007).