INTRODUCTION

Shoulder pain is the third most common cause of musculoskeletal disorders (MSDs), after low back pain and neck pain ***(Urwin et al., 1998).***

Rotator cuff injuries are the most common cause of shoulder pain and disability of the upper body, representing approximately 85% of the cases ***(Ostor et al., 2005; Naredo et al., 2002).***

The rotator cuff tears in particular have reported incidence of greater than 50% among the adult population ***(Loher and Uhthoff, 1987)*** and are associated with significant functional limitations commonly caused by the supraspinatus muscle.

The most common risk factors for such cases are: above 40 years of age, overweight, repetitive lifting or overhead activities, certain jobs like; tennis players, baseball pitchers, painters, carpenters and traumatic injuries (most common in young people ***(Silverstein et al., 1998).***

Supraspinatus tendon is part of the rotator cuff of the shoulder and is responsible for abduction of the upper limb ***(Simons et al., 1999).*** A tear or rupture of this tendon can occur in two ways; either partial or full thickness tear and most of the time it is accompanied with another rotator cuff muscle tear but it is the most commonly injured ***(Saladin, 2016).*** A partial tear means that the tendon fibers will not be completely disrupted yet a complete tear is the disruption of all the tendon fibers.

Diagnosis of the muscle tears is based on: history, clinical examination, and imaging using X Rays, CT scanning, MRI and ultrasonography. The role of imaging is to guide treatment decision ***(Post et al., 1983).*** The diagnosis of rotator cuff injury, tendinopathy, partial or full thickness tear, and its extent can determine whether the patient will undergo surgery or just will be managed conservatively ***(Ruotolo and Nottage, 2002; Mantone et al., 2000).*** Also the surgical approach, open versus arthroscopic, is chosen based on the imaging diagnosis ***(Mantone et al., 2000; Gartsman et al., 1998).***

MRI is now widely used and has the advantages of providing excellent soft tissue details, tendon retraction and extension of the tear to adjacent structures. MRI however, has certain disadvantages like being expensive, not readily available, difficult to interpret when adjacent metallic implant is present due to artefacts and has many contraindications like claustrophobia etc ***(Dill, 2008).***

Shoulder ultrasound has the advantages of being readily available, relatively inexpensive and non-invasive. Ultrasound however, having the disadvantages of being operator dependent, requiring standardized scanning technique and in comparison to MRI, it is constantly reported to have a lower sensitivity and specificity for detection of rotator cuff tears ***(Needell and Zlatkin, 1997).***

Nowadays, management of the tendon tears is either; conservative which includes oral drugs (like NSAIDs), injections with corticosteroids and physical therapy ***(Longo et al., 2012; Via et al., 2013)*** or surgical repair depending on the type and extent of the tear (partial or complete*)*.

The treatment of symptomatic partial rotator cuff (RC) tear is a challenge to orthopaedic surgeons as it can vary from conservative to surgical repair. Surgery can improve patient outcome, but the incidence of delayed healing, infection, stiffness of the shoulder, and other tendon injuries have a comparatively high incidence at about 6%-11% ***(Randelli et al., 2008).*** Rotator cuff (RC) re-tears have been shown to happen in 11%- 94% of RC repairs, depending on the extent of the tear and the level of tendon disintegrations ***(Cheung et al., 2010; Randelli et al., 2011).***

Recently, there has been growing interest in the area of biological therapies to assist musculoskeletal repair. There are numerous well established studies about using blood and its by-products to improve the healing course and decrease the pain of the tendon tears ***(Asfaha et al., 2007; Chahal et al., 2012).*** Platelet- rich plasma (PRP), a whole blood by-product containing a great concentrations of platelets that, when triggered, endure degranulation to discharge varying kinds of growth factors with restorative properties. These growth factors comprise platelet- derived growth factors, which stimulates cell mitosis, transforming growth factor B, which is concentrated in collagen synthesis and morphogenesis, and vascular endothelial growth factor, which aids to induce endothelial cell multiplying and migration, thus commencing an angiogenic response ***(Hollinger et al., 2008; Sanchez et al., 2009; Hall et al., 2009).*** Besides, platelets have been recognized to be having pain-relieving properties by discharging protease triggered receptor 4 peptides ***(Asfaha et al., 2007).***

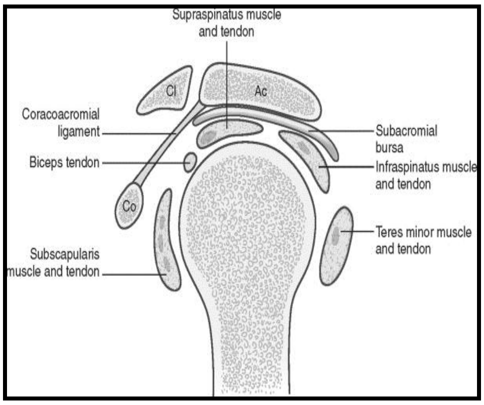
AIM OF THE WORK

Based on these facts, our study efforts seeked assessment of the role of ultrasound guided platelet rich plasma injection in supraspinatus tendon partial thickness tear.

GROSS ANATOMY OF THE ROTATOR CUFF MUSCLES

T**he rotator cuff interval** is present between the superior aspect of the subscapularis tendon and the inferior aspect of the supraspinatus tendon. This interval contains the coraco-humeral ligament and the superior gleno-humeral ligament (SGL) ***(Tuoheti et al., 2005).***

The supraspinatus, infraspinatus, teres minor and subscapularis muscles form the rotator cuff. Their main function is to centralize the humeral head, limiting superior translation during abduction ***(Fig.1) and (Fig.2).*** The supraspinatus, infraspinatus, and teres minor tendons insert into the greater tuberosity, whereas the subscapularis tendon inserts on the lesser tuberosity. The subscapularis tendon presents on the anterior aspect of the anterior capsule of the gleno-humeral joint and its superior portion is intra-articular. Attenuation of the subscapularis muscle from repeated dislocations may be a cause of shoulder joint instability ***(Meyer et al., 2005).***



A b

Figure 1 (a-b); (a) Demonstrative sagittal view of the shoulder joint**.** (b) T1 sagittal oblique view of the shoulder. The coraco-acromial ligament (*open arrow*) anterior to the shoulder is a low signal band between its attachments on the acromion (A) and the coracoid process (C) ***(Stoller, 1997).***

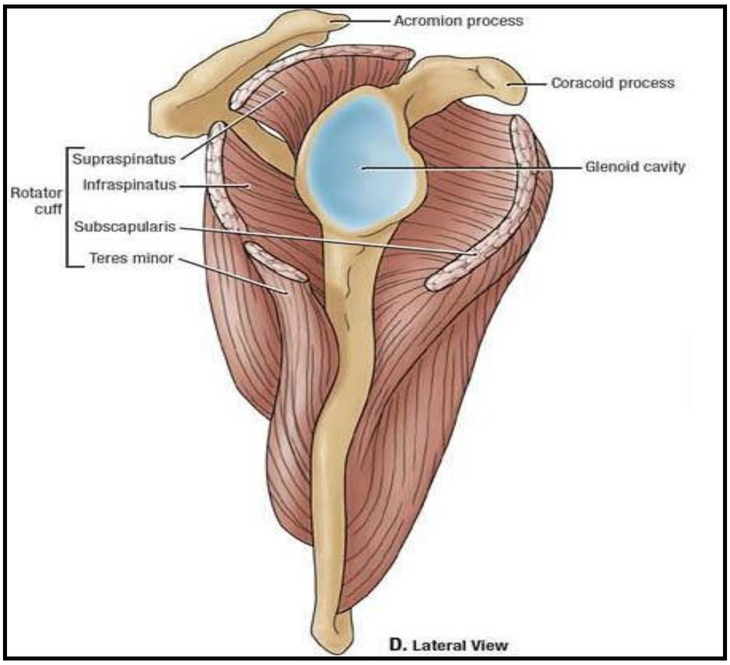


Figure 2: Graphic image of a lateral view of the rotator cuff muscle ***(Williams and Dyson, 2000).***

A- The supraspinatus muscle:

The supraspinatus muscle originates from the medial two thirds of the supraspinatus fossa of the scapula and from the strong supraspinatus fascia. The muscle converges into 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 ***(Fig.3) (Pink et al., 1990).***

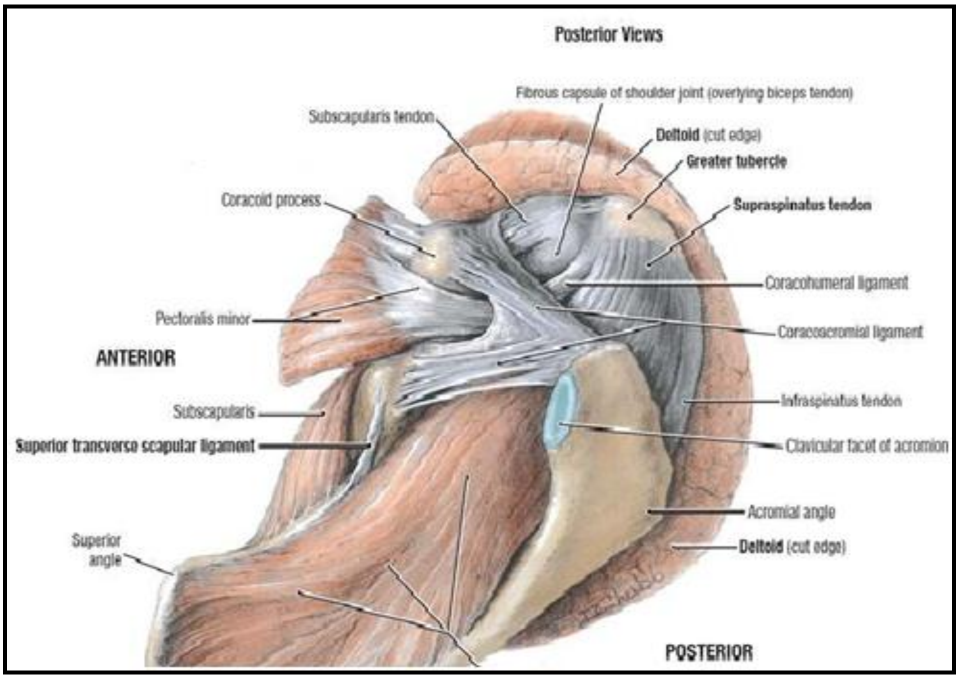


Figure 3: Graphic image of a superior view of the supraspinatus muscle and shoulder ligaments ***(Williams and Dyson, 2000).***

B- The Infraspinatus Muscle:

The infraspinatus muscle arises from the medial two thirds of the infraspinatus fossa, the superficial fibers arise from the infraspinatus fascia which covers the muscle. The tendon of the muscle inserts in the middle facet of the greater tuberosity of the humerus. As it crosses the capsule of the shoulder joint, some of the fibers blend with the capsule. The tendon is in common insertion antero-superiorly with the supraspinatus tendon and inferiorly with the teres minor tendon ***(Fig.4) (Williams and Dyson, 2000).***

C- The Subscapularis Muscle:

It is the anterior component of the rotator cuff. It arises from the subscapularis fossa. It inserts in the lesser tuberosity of the humerus, some fibers blend with the capsule of the shoulder joint, other fibers sometimes crosses the inter-tubercular sulcus ***(Fig.4) (Hodler et al.,2000).***

D- Teres Minor Muscle:

This is a small muscle that arises from 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 of the facets of the greater tuberosity of the humerus ***(Fig.4) (Hodler et al., 2000).***

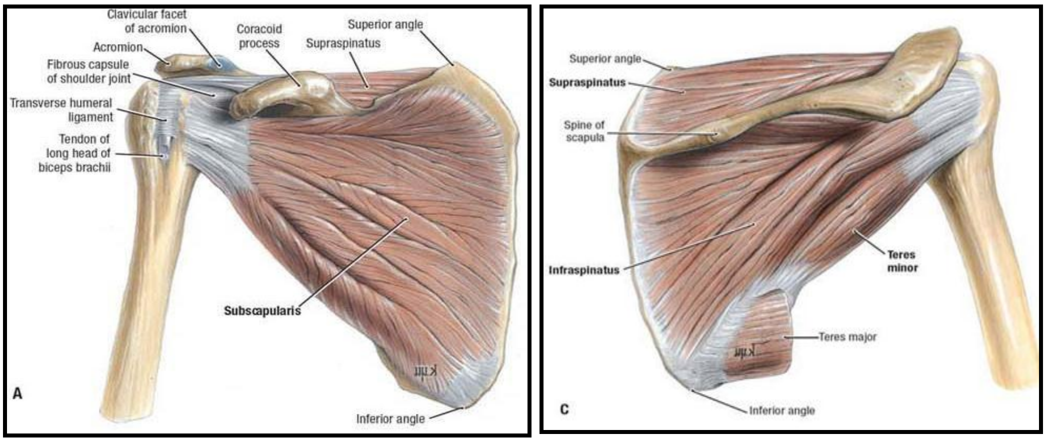


Figure 4: Graphic image of a coronal section A-posterior view B-anterior view of the rotator cuff muscles ***(Williams and Dyson, 2000).***

Bursae related to the shoulder

A-Subscapular bursa:

It is present between the subscapularis tendon and the underlying joint capsule. It usually communicates with the synovial cavity through an opening between the superior and middle gleno-humeral ligaments in the anterior part of the capsule ***(Stoller, 1997)***.

B- Subdeltoid bursa:

It is a large bursa situated between the deep surface of the deltoid muscle and the joint capsule, over the upper and lateral aspect of the humerus. There is no communication between it and the synovial cavity ***(Stoller, 1997)***.

It is surrounded by one to two millimetres of T1-hyperintense fat, which increases in thickness with age and increasing subcutaneous fat ***(Cook et al., 2011).***

C- Subacromial bursa:

It lies between the deep surface of the acromion and the supraspinatous tendon overlying the joint capsule ***(Stoller, 1997)***. However, in the setting of a rotator cuff tear, a communication between these two spaces can develop ***(Cook et al., 2011).*** It is best visualized using axial imaging.

D- Subcoracoid bursa:

May lie between the coracoid process and the capsule, or it may be an extension from the subacromial bursa ***(Stoller, 1997)***.

The subacromial, subdeltoid, and subcoracoid bursae are sometimes seen as one large, continuous bursa. The subcoracoid bursa is best seen on oblique sagittal or coronal T2-weighted images ***(Fig.5) (Cook et al., 2011)***.

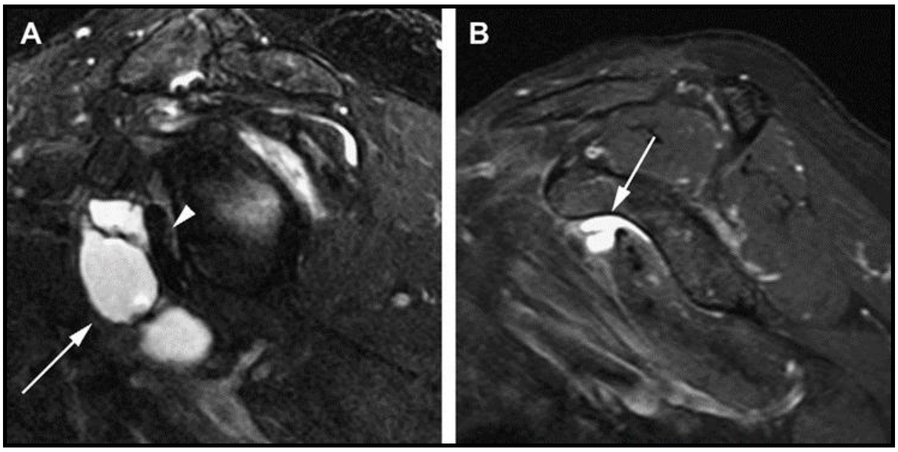


Figure 5: Subcoracoid bursa and superior subscapularis recess. Sagittal-oblique T2-weighted with fat-saturation MR images show (A) markedly distended subcoracoid bursa (arrow) located anterior to the subscapularis muscle and tendon (arrowhead). (B) Note that more medial to (A), the superior subscapularis recess (arrow) takes on a more saddle-bag like configuration over the subscapularis ***(Cook et al., 2011).***

RADIOLOGICAL MRI ANATOMY OF THE ROTATOR CUFF MUSCLES AND TECHNIQUE

Normal axial MRI imaging

Muscles have an intermediate to high signal intensity on all spin echo pulse sequences. Fat including; subcutaneous fat, inter-muscular fat planes, and bone marrow have the highest signal on short TR/TE or long TR short TE images, due to their relatively short T1 time ***(Fig.6) (Zlatkin, 2003).***

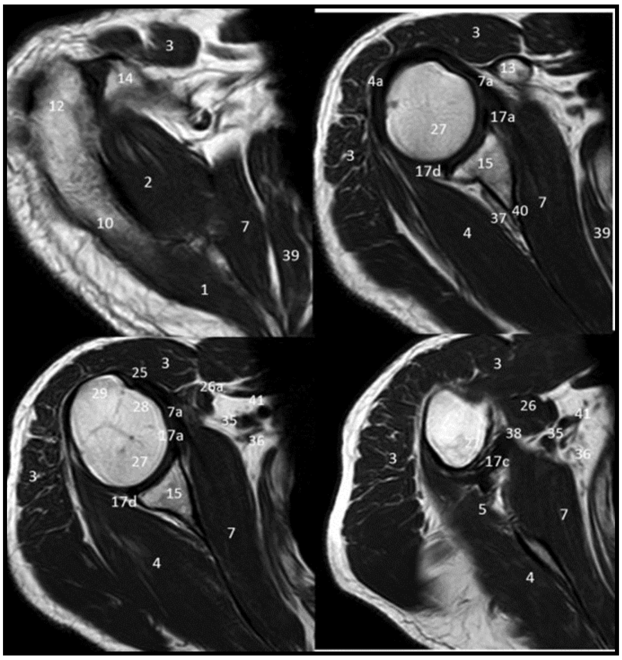


Figure 6: Shows MRI anatomy of the shoulder muscles.

Axial images. Trapezius muscle. 2. supraspinatus muscle; 2a. supraspinatus tendon. 3. Deltoid muscle. 4. Infraspinatus muscle; 4a. infraspinatus tendon., 5. Teres minor muscle; 5a. teres minor tendon. 6. Teres major muscle. 7. Subscapularis muscle; 7a. subscapularis tendon. 8. suprascapular fossa. 9. Infrascapular fossa. 10. Spine of scapula. 11. Body of the scapula. 12. Acromion. 13. Coracoid process. 14. Clavicle. 15. Glenoid. 16. Glenoid tuberosity. 17a. Anterior labrum; 17b. superior labrum; 17c. inferior labrum; 17d. posterior labrum. 18. Coracohumeral ligament. 19. Coracoclavicular ligament. 20. Triceps long portion. 21. Coracobrachial. 22. Pectoralis minor tendon. 23. pectoralis major. 24. Coracoacromial ligament. 25. Long head of biceps tendon. 26. Biceps brachii muscle; 26a. short head of the biceps tendon. 27. Humeral head. 28. Lesser tubercle. 29. Greater tubercle. 30. Surgical neck. 31.Humeral shaft. 32. Bicipital groove. 33. Posterior circumflex humeral artery and axillary nerve. 34. Circumflex scapular artery. 35. Axillary artery. 36. Brachial plexus. 37. suprascapular artery and nerve. 38. Inferior glenohumeral ligament/capsule. 39. Serrato. 40. Scapular notch. 41. Axillary vein.

Technique

MR imaging offers excellent depiction of both soft tissue and osseous structures. Recent advances in MR imaging have contributed to shorter scanning times and higher-quality images. An understanding of imaging techniques, normal variants, technical artifacts, and diagnostic pitfalls will improve diagnostic accuracy on shoulder studies ***(Magee et al., 2004).***

Patient positioning

Proper patient positioning is important to consider at the outset of the examination. The patient should be supine with the head directed towards the scanner bore. To avoid transmission of respiratory motion, the patient's arms should rest to the side of the body and should not be placed on the abdomen. The preferred positioning of the patient's arm is neutral to slightly externally rotated. Internal rotation causes laxity of the anterior capsular structures and increased overlap of muscular and tendinous components of the rotator cuff, both of which can interfere with evaluation ***(Fig.7) (Bergin and Schweitzer, 2003).***

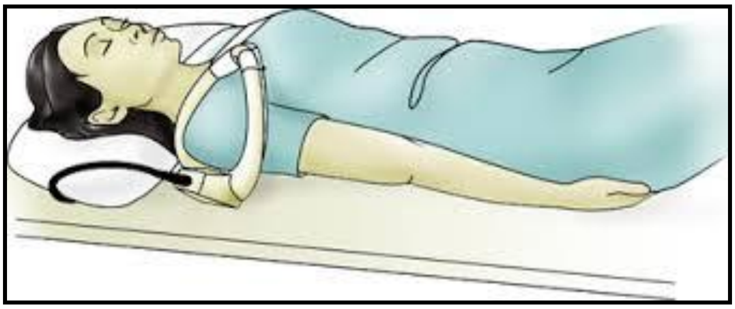


Figure 7: Patient position and single loop coil for MRI shoulder ***(Bergin and Schweitzer, 2003).***

Surface coils

The use of surface coils is requisite for shoulder MRI. The higher signal-to noise ratio produced by these coils allows for improved spatial resolution; both of these factors improve the diagnostic ability of MR exams. The most basic and commonly used coil is the single-loop coil. It is a linear coil in a curved configuration. Its main disadvantage is the sharp decrease in image homogeneity and signal to noise ratio with increasing distance from the center of the coil. Flexible coils are those that wrap around and conform to the anatomic area of interest. They offer improved patient comfort ***(Michael et al., 2003).***

Surface coils based on quadrature and phased array technology provide further improvement in signal-to-noise ratio, which can be used to implement smaller field of view, thinner slices, and higher –resolution matrices, all of which contribute to better spatial resolution ***(Michael et al., 2003).***

Imaging planes

Preliminary scout images are obtained in the coronal plane using short TR spin echo or gradient echo sequences. These images can be acquired using the body coil or a surface coil with a large field of view. The primary purpose of these scout images is to serve as a localizer for subsequent pulse sequences.

The next set of images is acquired in the trans-axial plane.

Trans-axial images should cover the area between the inferior glenoid fossa and the acromio-clavicular joint. These images provide good visualization of the joint capsule, labrum, subscapularis muscle, and long head of the biceps. Another purpose of trans-axial images is to orient the appropriate plane for prescription of subsequent coronal and sagittal oblique images ***(Fig.8) (Michael et al., 2003).***

Coronal oblique images are obtained in a plane parallel to the supraspinatus tendon. The course of the tendon is slightly oblique to the direction of the muscle fibers, and it also diverges slightly from the plane of the glenohumeral joint. Coverage in the antero-posterior direction should proceed from the subscapularis muscle and tendon to the infraspinatus & teres minor muscles posteriorly. These images are the primary means for evaluation of the rotator cuff for potential tears or other abnormalities and for assessing the amount of retraction in patients with full thickness rotator cuff tears. Coronal oblique images are also helpful for assessing the superior and inferior portions of the fibro-cartilaginous glenoid labrum and the subscapularis notch ***(Fig.8) (Michael et al., 2003).***

Sagittal oblique images are obtained in plane perpendicular to that of the supraspinatus tendon. Coverage should extend from the glenoid fossa medially to the cortex of the humerus laterally ***(Fig.8) (Michael et al., 2003).***