INTRODUCTION

Shoulder pain is the third most common cause of musculoskeletal disorders (MSDs), after low back pain and neck pain. Rotator cuff injuries are the most common cause of shoulder pain and disability, representing approximately 85% of the cases ***(Ostor et al., 2005).***

Rotator cuff tears are a common orthopedic problem, and often these tears are so-called partial tears of the rotator cuff. A partial tear of the rotator cuff is an area of damage or degeneration to the rotator cuff tendons, where the tear does not go all the way through the tendons ***(Checketts et al., 2018).***

The main risk factors for such cases include overweight, old age, repetitive lifting or overhead activities, certain jobs like; painters, carpenters and traumatic injuries (most common in young people) ***(Ebert et al., 2017).***

Supraspinatus tendon is part of the rotator cuff of the shoulder and is responsible for abduction of the upper limb**.** 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 et al., 2016).***

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. 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).***

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 and difficult to interpret when adjacent metallic implant is present due to artefacts and has many contraindications like claustrophobia etc ***(Dill et al., 2008).***

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 orthopedic 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 concentration 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).***

Recent studies demonstrated that there is conclusive benefit for reducing pain and improving shoulder function in partial RC tears with ultrasound-guided PRP ***(Sengodan et al., 2017).***

AIM OF THE WORK

To the assessment of rotator cuff partial tear treatment with ultrasound guided platelet rich plasma injection.

REVIEW OF LITERATURE

Anatomy of the Rotator Cuff Muscles

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 ***(Meyer et al., 2005). (Fig 1)***

The supraspinatus, infraspinatus, and teres minor tendons insert into the humeral greater tuberosity, whereas the subscapularis tendon inserts on the lesser tuberosity ***(Meyer et al., 2005). (Fig 2)***

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

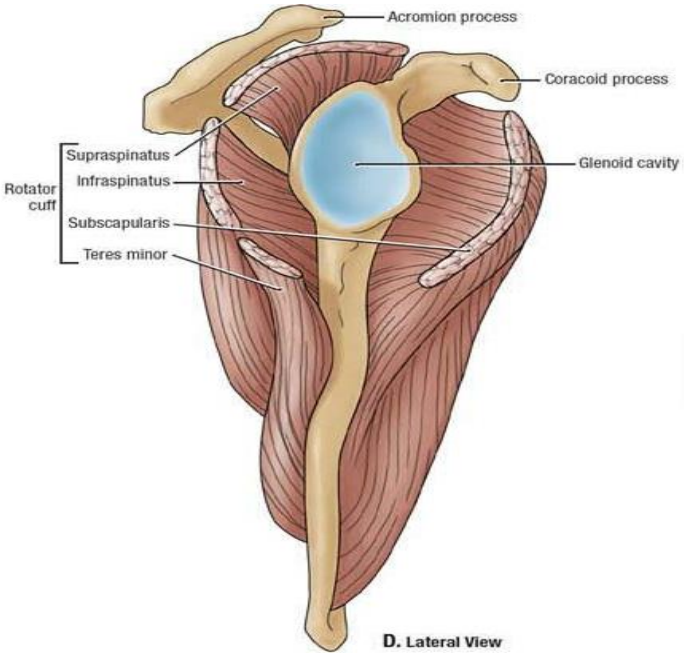


Fig. 1: Graphic image of a lateral view of the rotator cuff muscle. Quoted from ***(Williams and Dyson, 2000).***

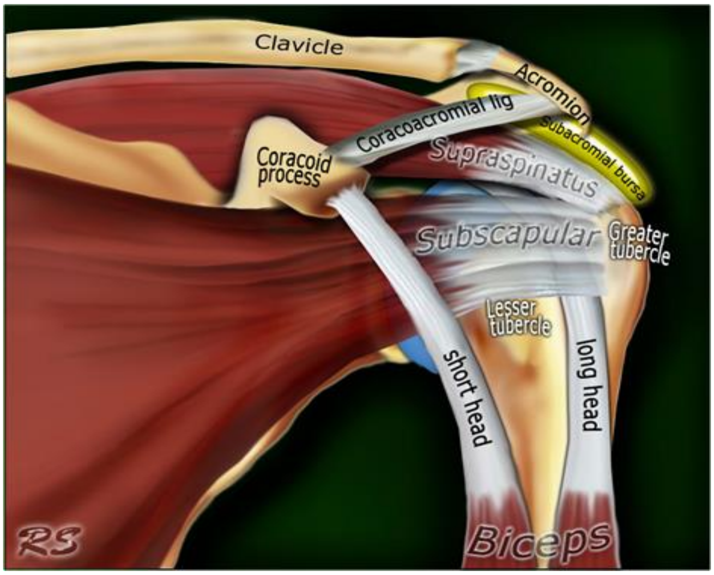
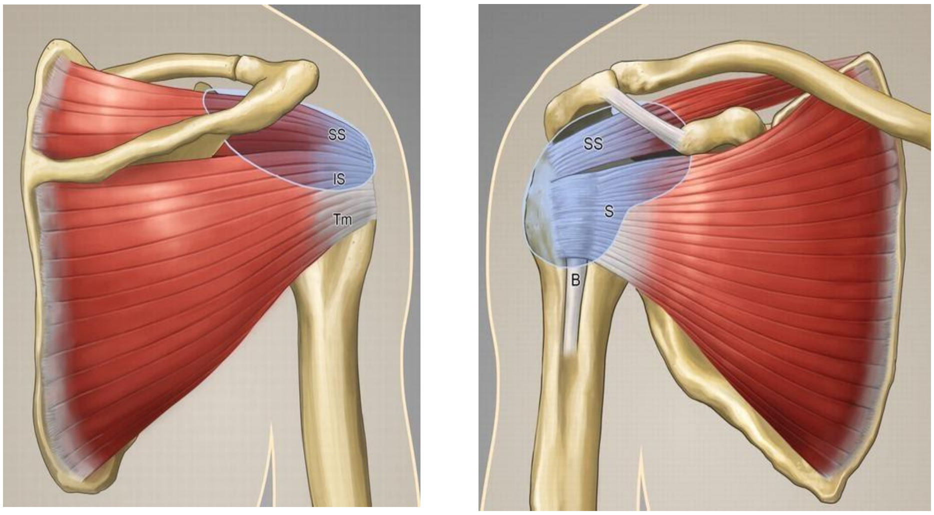


Fig. 2: Graphic view of the supraspinatus, subscapularis and biceps brachii muscles and tendons. *Quoted from* ***(Williams and Dyson, 2000).***

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 tendinous insertion is in common posteriorly, with the infraspinatus tendon and anteriorly, with the coraco-humeral ligaments ***(Williams and Dyson, 2000).***



(a) **(b)**

Fig. 3: Shoulder anatomy Illustrations of **(a)** anterior and **(b)** posterior shoulder show supraspinatus (SS), infraspinatus (IS), subscapularis (S), teres minor (Tm), and long head of the biceps brachii tendon (B). Subacromial-subdeltoid bursa is overlying the rotator cuff (light blue). *Quoted* from (Image courtesy of Carolyn Nowak, Ann Arbor, Mich.)

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- 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).***

D- The Subscapularis Muscle:

It is the anterior component of the rotator cuff. It arises from the subscapularis fossa and inserts in the lesser tuberosity of the humerus. ***(Fig.4)*** (***Hodler et al., 2000).***

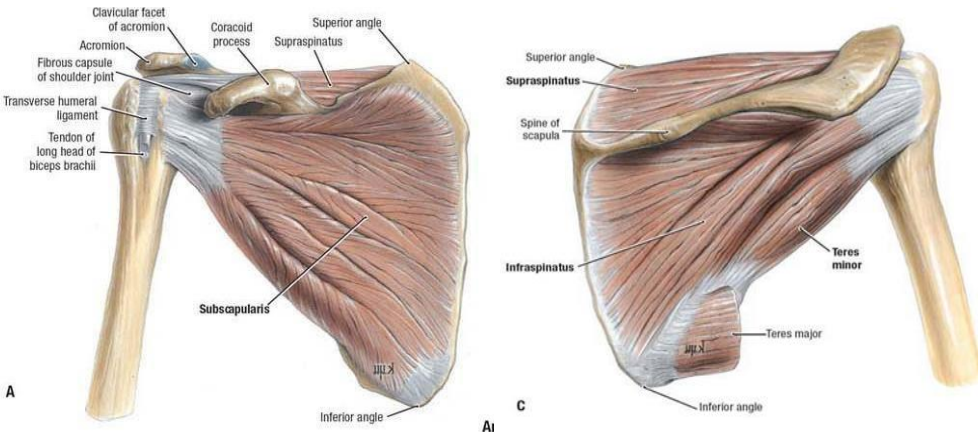


Fig. 4: Graphic image of a coronal section A-posterior view B-anterior view of the rotator cuff muscles. *Quoted* from ***(Williams and Dyson, 2000).***

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 (**Fig.5)** (***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 (Fig.5) ***(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).***

***<u>C- Subacromial bursa</u>*:**

It lies between the deep surface of the acromion and the supraspinatus tendon overlying the joint capsule ***(Stoller, 1997)***. However, in the setting of a rotator cuff tear, a communication between these two spaces can develop (Fig.5) ***(Cook et al., 2011).*** It is best visualized using axial imaging.

***<u>D- Subcoracoid bursa</u>*:**

May lie between the coracoid process and the capsule, or it may be an extension from the subacromial bursa **(Fig.5)** ***(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 ***(Cook et al., 2011)***.

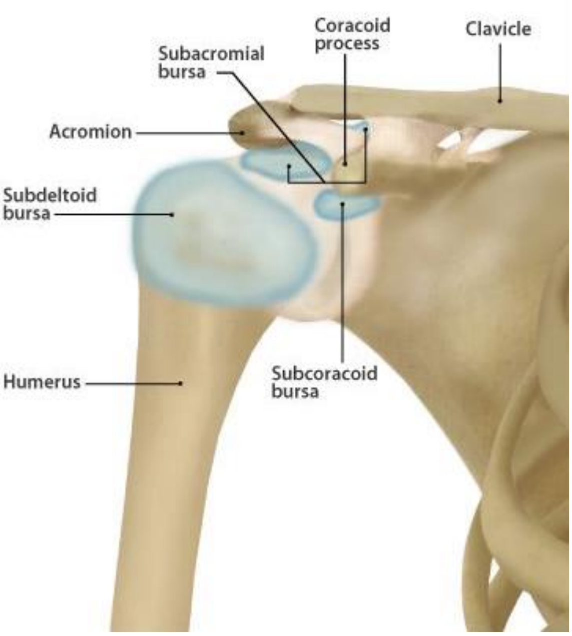


Fig. 5: Anatomy Illustrations of the shoulder joint related bursae. *Quoted* from ***(Cook et al., 2011)***.

Radiological MRI anatomy of the rotator cuff muscles and technique

<u>Normal axial MRI imaging</u>

Muscles have an intermediate to high signal intensity on all spin echo pulse sequences. Fat including; subcutaneous fat, intermuscular 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).***

Fig. 6: Shows MRI anatomy of the shoulder muscles. Axial images.1. 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

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. ***(Fig.7) (Bergin & Schweitzer, 2003).***

Fig. 7: Patient position and single loop coil for MRI shoulder. *Quoted* from ***(Bergin & 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 ***(Michael et al., 2003).***

Imaging planes

According to *Michael et al. (2003):*

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)***

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)***

Sagittal oblique images are obtained in a 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)***

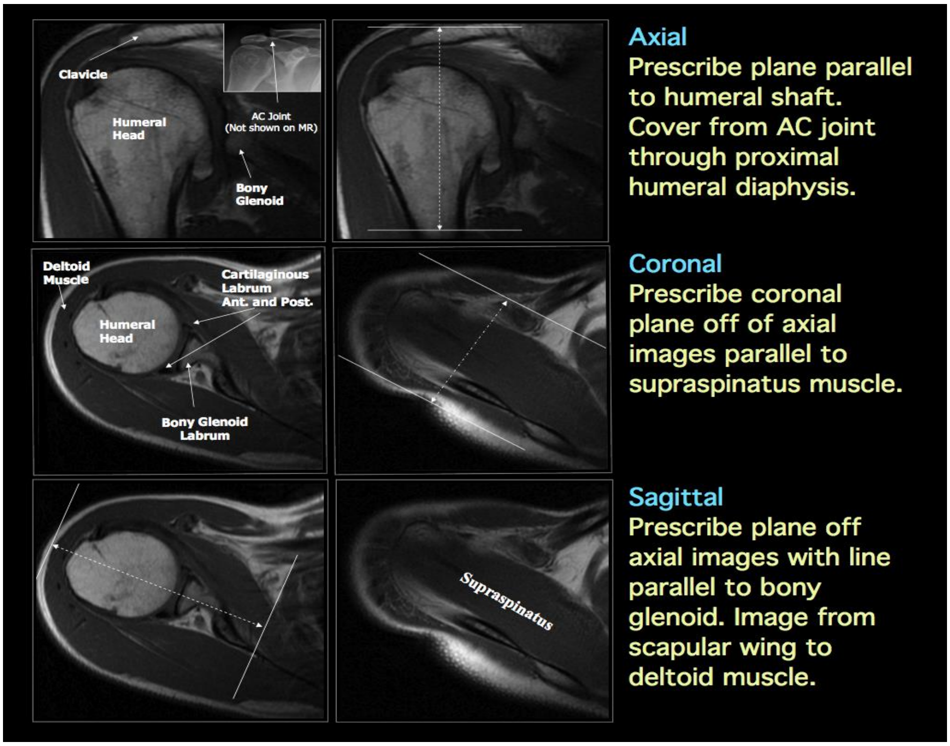


Fig. 8: Imaging planes of MRI shoulder. *Quoted* from ***(Michael et al., 2003).***