"COMPARISION OF MAGNETIC RESONANCE IMAGING AND ARTHROSCOPIC FINDINGS IN EVALUATION OF SHOULDER PATHOLOGY" – A ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY

By

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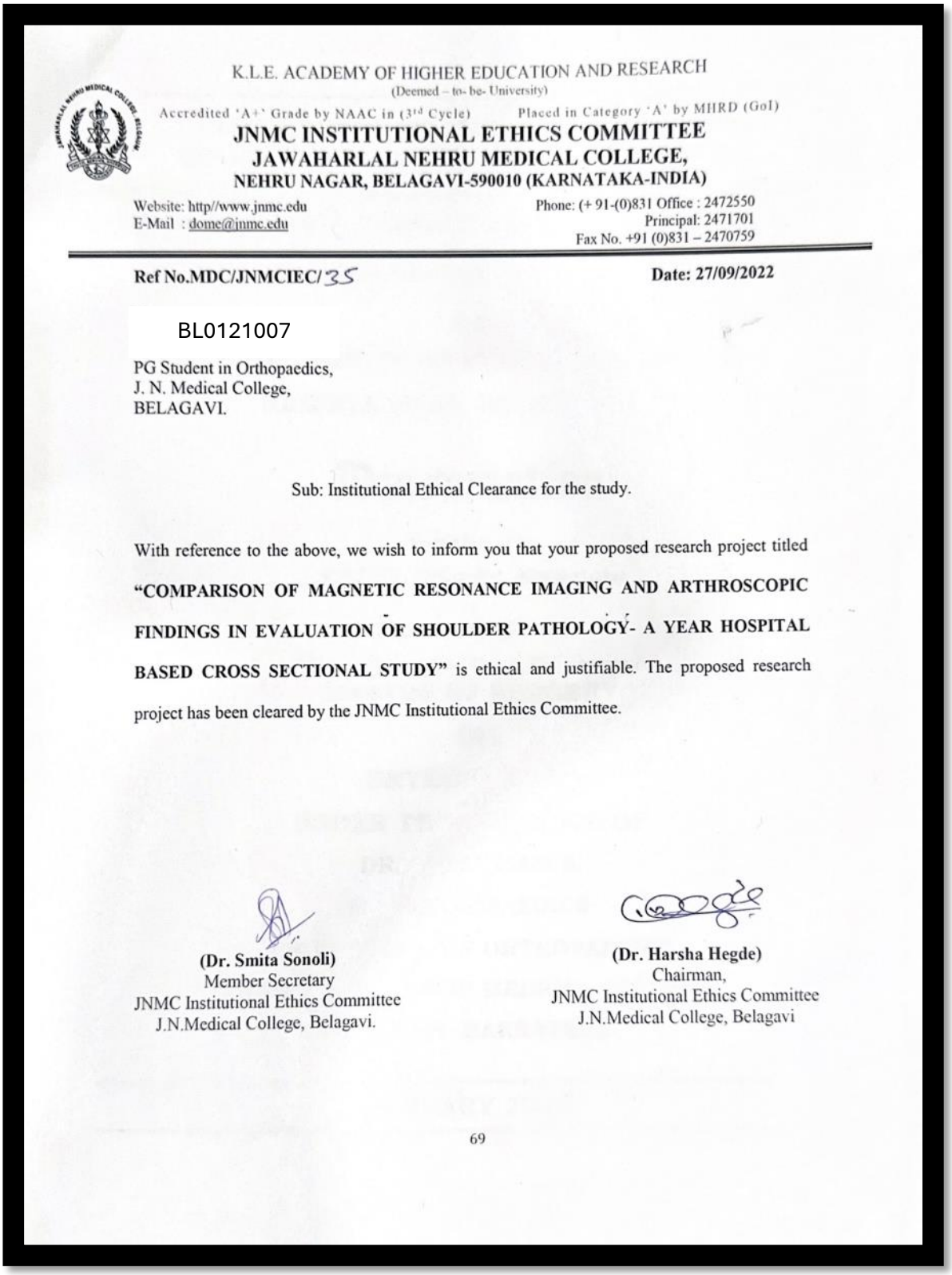

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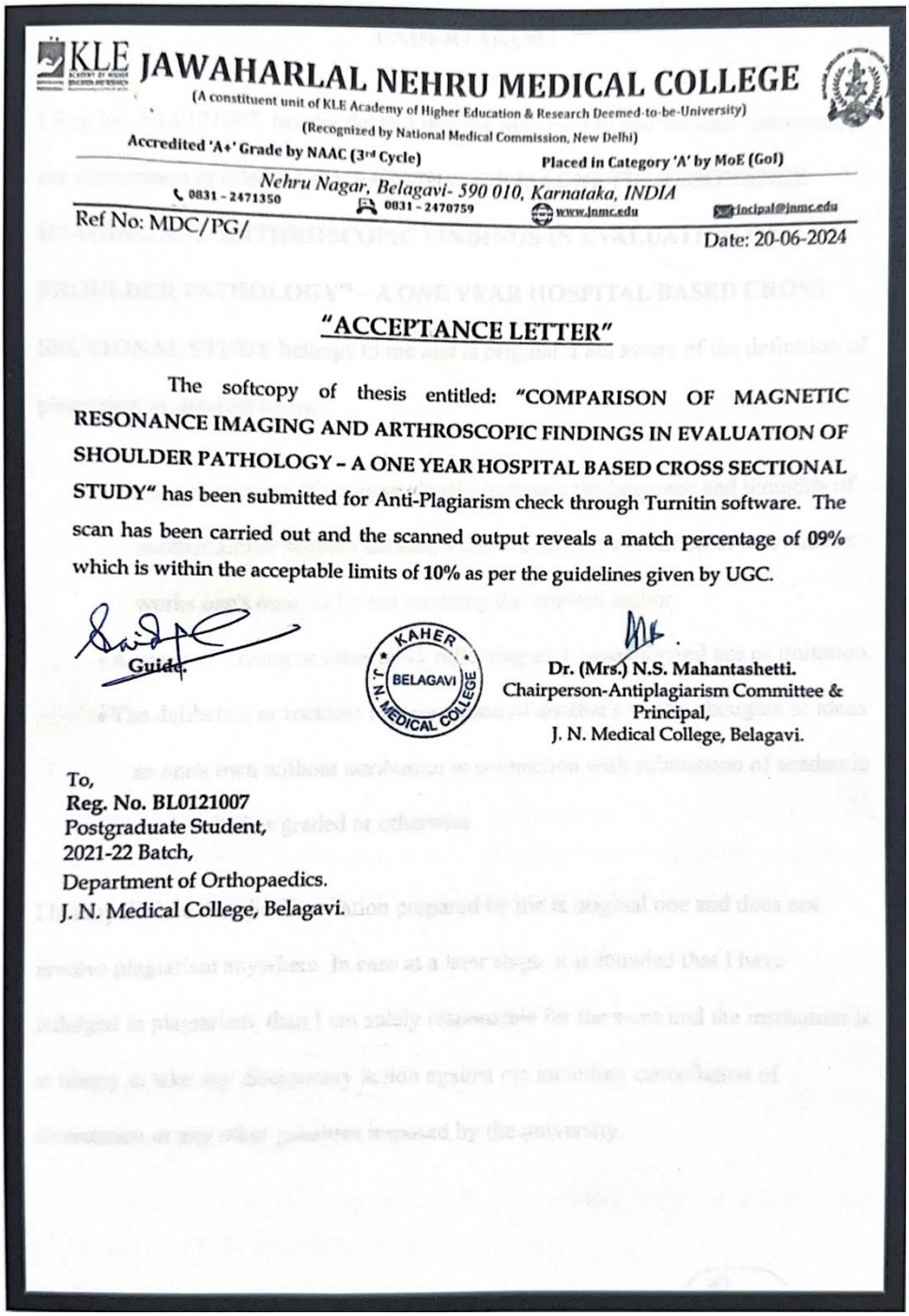

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LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
MRI	MAGNETIC RESONANCE IMAGAING
SLAP	SUPERIOR LABRUM ANTERIOR AND POSTERIOR
LHB	LONG HEAD OF BICEPS
SGHL	SUPERIOR GLENO-HUMERAL LIGAMENT
MGHL	MIDDLE GLENO-HUMERAL LIGAMENT
IGHL	INFERIOR GLENO-HUMERAL LIGAMENT
USG	ULTRASOUND SONOGRAPHY
ROM	RANGE OF MOTION
OPD	OUTPATIENT DEPARTMENT
PPV	POSITIVE PREDICTIVE VALUE
NPV	NEGATIVE PREDICTIVE VALUE

ABSTRACT

Introduction: Common Musculo-skeletal problem arises from the shoulder joint after hip and spine, affecting daily activities and financial earning of the patient. MRI has commonly been used to Aid the diagnosis, provides superior detailing of ligamentous, cartilaginous, and labral structures but Several studies have shown that there is a discrepancy between MRI findings and the findings seen in Arthroscopy. This affects the preoperative planning and management as certain pathologies might be missed on MRI which may or may not require surgical fixation.

Objectives: To compare the efficacy of MRI in diagnosis shoulder pathologies in comparison to arthroscopy, considering arthroscopy as the gold standard.

Materials and methods: 61 patients with shoulder pain and restriction of shoulder movements were studied. If indicated, Consent was taken and arthroscopy of the affected shoulder was done, and the same structures were inspected and compared to the preoperative MRI.

Results: Mean age of subjects was around 41-60, with a male predominance, showing correlation with diabetes mellitus. For rotator cuff sensitivity, specificity, PPV & NPV of 63.15%, 95.24%, 85.71% and 85.11% respectively. For SLAP tears sensitivity, specificity, PPV & NPV of 63.15%, 95.24%, 85.71% and 85.11% respectively. For Bankarts lesion sensitivity, specificity, PPV & NPV of 100.0%, 94.91%, 100.0% and 40.0% respectively also for Hill Sachs lesions sensitivity, specificity, PPV & NPV of 75.0%, 98.24%, 75.0% and 98.24% respectively.

Conclusion: For Rotator cuff tears, Bankarts lesion, Hill Sachs lesion MRI proves to be a accurate diagnostic tool where for SLAP tears arthroscopy is still the gold standard.

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INTRODUCTION

For an orthopaedician, patients presenting with shoulder pain form the 3rd most frequent group of patients seeking medical attention after spine and knee pain(1). It includes a spectrum of diseases such as rotator-cuff injuries, SLAP tears, Bankart lesion, Hill-Sachs lesion, shoulder instability etc. Since shoulder pathology causes significant restriction in daily activities, both directly and indirectly, this affects the financial earnings of the patient, thereby has an influence on their quality of life(2).

Even with detailed clinical history & examination, there is a poor Inter-Observer and Intra Observer reliability(3). The patients can present to the OPD with varying symptoms, insidious in onset or acute presentation(4).

Initial modality of choice for evaluation is plain X-ray. However, as these can only detect bony pathologies, they are often normal and thereby the surgeon needs additional alternate imaging modalities for aid in diagnosis.

Hence, to identify the lesions in the soft tissue as well as bony involvement, Magnetic Resonance Imaging (MRI) is used to obtain detailed imaging sequences which are offered by the MRI. MRI(Magnetic Resonance Imaging) has been a superior imaging modality in identifying diseases or injuries around the shoulder joint, as it provides the detailed information of the anatomy of the shoulder.

Even though Magnetic Resonance Imaging is effective for shoulder joint imaging, its high cost (~Rupees 7000 per scan) and long waiting times for the scans pose challenges. Moreover, patients often struggle with lying still for extended periods (approx.~ 20 min for shoulder MRI) during the scan (absolute stillness is required for the entire duration of the scan. Even slight movements cause disturbances in the final

imaging), particularly if they're in pain or claustrophobic. These factors may prompt surgeons and patients to consider alternative imaging methods or carefully assess the need for MRI in each case.

Even with the improvement of the MRI technology and our knowledge about shoulder pathologies, studies have shown the discrepancy between the MRI findings and the arthroscopy findings. This affects the planning for the management of a case as certain pathologies might be missed on MRI which may or may not require surgical fixation.

An important headway was made in the diagnosis & management of shoulder pathologies with the advent of arthroscopy for the shoulder. However, due to the invasive nature of the procedure, arthroscopy requires hospitalization and administration of anaesthesia and it is also associated with the risks and complications of surgery such as injury to adjacent neurovascular structures- axillary nerve, brachial plexus, infection, post operative shoulder stiffness, anaesthesia related complications, thromboembolism, and the financial burden on the patient but it provides a clear visualization of anatomy of shoulder(5,6).

Only few comparative studies have been done in India regarding the diagnosis of shoulder pathologies but with ever changing MRI technologies, hence this study was done to identify the short comings of MRI when compared to arthroscopy in the Indian setup and help us take necessary steps to improve patient care.

AIMS AND OBJECTIVES

To compare the efficacy of Magnetic Resonance Imaging (MRI) in diagnosis of shoulder pathologies in comparison to arthroscopy, with shoulder arthroscopy as the gold standard

ANATOMY

The term ‘shoulder joint’ is commonly used in reference to the gleno-humeral joint, however considering surgical anatomy and the functions of the shoulder, it is obvious that the shoulder girdle-is a complex of five functional articulations.

The highly developed functions of the hand require it to be placed almost virtually in any plane. Movements along this complex system of articulations produce a rhythmic and co-ordinated movements of the arm, forearm and hand. As humans evolved there is a trade for extraordinary range of movements at the cost of instability unlike the hip joint.

The shoulder girdles are formed by the clavicle, scapula, and humerus.

Humerus

The name Humerus is derived from a latin word called ‘umerus’ which means upper arm. Proximally it forms the gleno-humeral joint by articulating with the scaphoid. This ball and socket joint is lined by a synovial membrane. This allows a dynamic range of movements along multiple axes. Such movements are possible primarily due to the rotator cuff muscle with the assistance of pectoralis major, deltoid, serratus anterior and other muscles. The presence of multiple bursae around

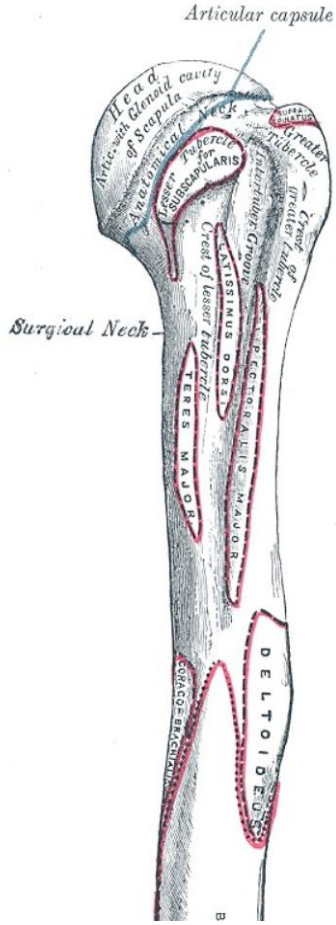


Figure 1:Proximal Humerus anatomy with Muscle attachments.

the shoulder joint allows a smooth frictionless mobility. A total of 6 bursae surrounds the shoulder joint

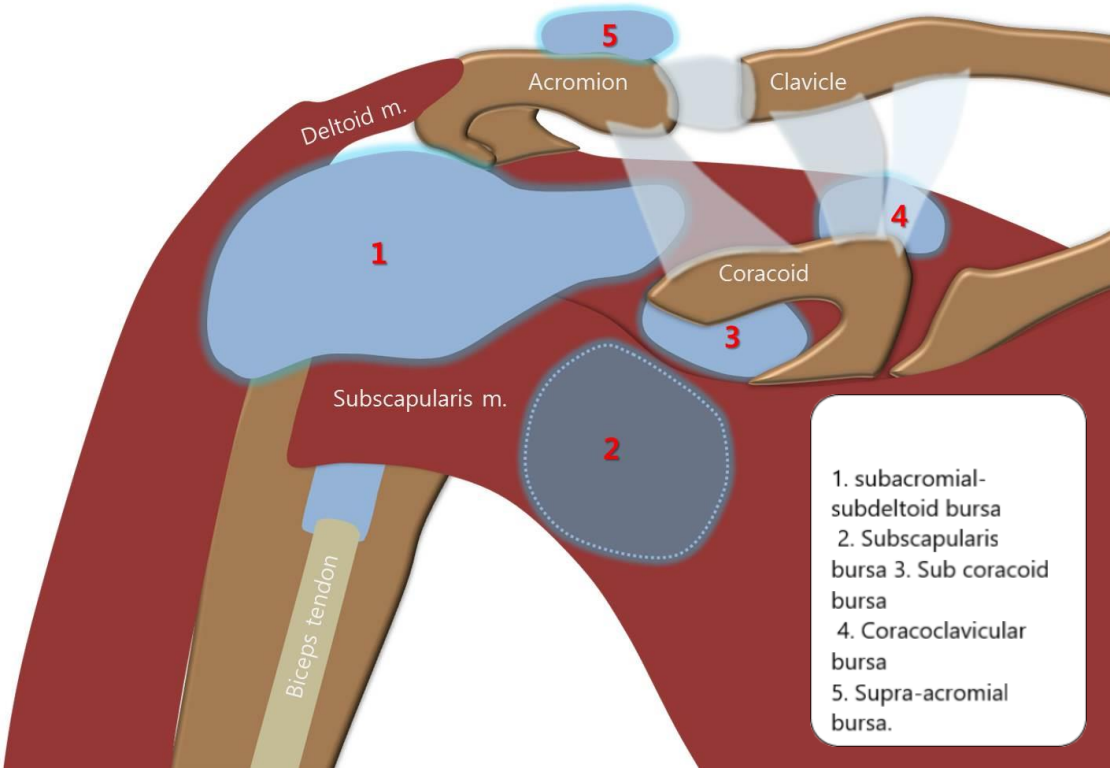


Figure 2:Bursae around shoulder

Scapula

Also known as the shoulder blade. It is a flat robust bone, positioned back of the thoracic wall. Scapula articulates with humerus and clavicle (acromio-clavicular joint). Due the multiple muscle attachments to the scapula (in total 17 muscles attach to scapula) it is uncommon to fracture(7).

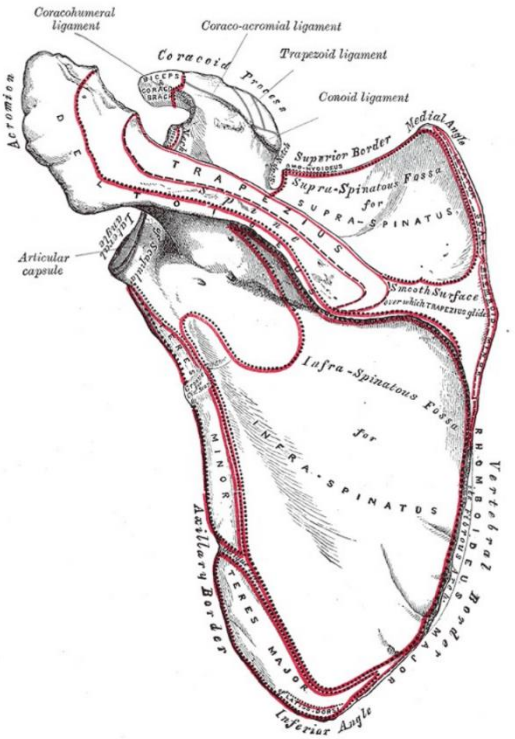


Figure 3:Scapula with Muscle attachments.

Clavicle

All long bones ossify through cartilaginous ossification, but the clavicle is the only horizontal long bone that is palpable along its entire length and has a distinct embryology where it goes through membranous ossification. The only bony attachment that tethers the upper limb to the trunk. Clavicular attachments protect neurovascular structures posteriorly (subclavian vessels and the brachial plexus) and provide important function and range of motion for the upper extremities,

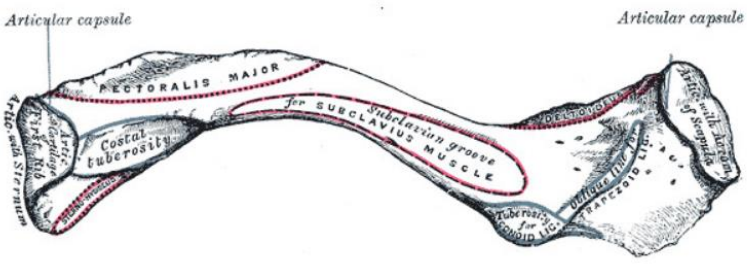


Figure 4:Anterior surface of clavicle.

despite it’s smaller size when compared to other supporting structures in the body. It is also involved in the transferring of forces from the upper limb to trunk.

The intricate mechanism that permits the scapula to glide along the posterior wall of the thoracic cage is made possible by the clavicle. This process is essential for the entire range of motion of the upper extremities(8).

The shoulder joint is a complex of five functional articulations, movements at these complex articulations allow the hand to be placed in the most optimum position for the desired activities. The following are the joints around the shoulder-

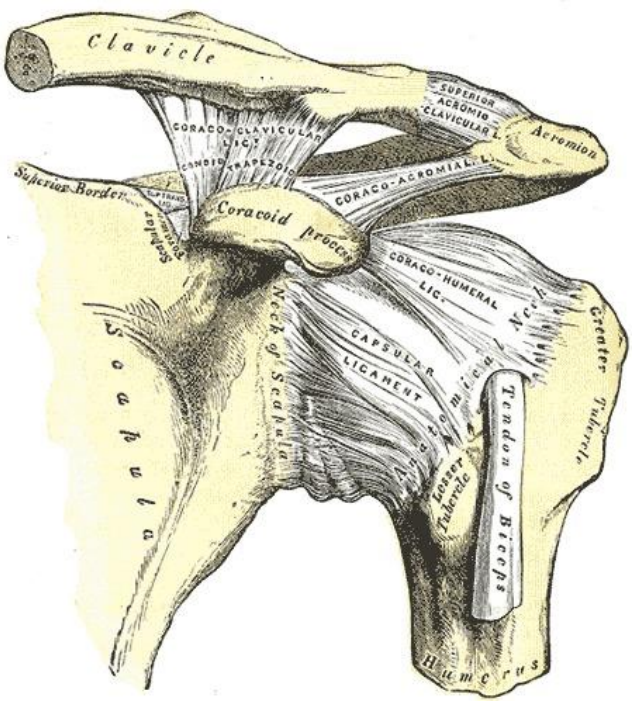


Figure 5:Shoulder joint with capsule and ligaments.

1)**The Gleno-Humeral Joint:**

It is a ball and socket type of joint formed by the head of humerus which forms the ball and glenoid cavity which forms the socket of the shoulder joint. It is surrounded by a protective synovial lining.

The dimensions of the Glenoid Cavity and the Humeral Head and, forms the articulation, but are not proportionate, as the fossa accommodates less than 1/3rd of the Head of Humerus, and Fibro-Cartilaginous ring like structure called the Labrum compensates this disproportionality at the expense of joint stability but increased ranges of motion This joint has a generous range of motion.

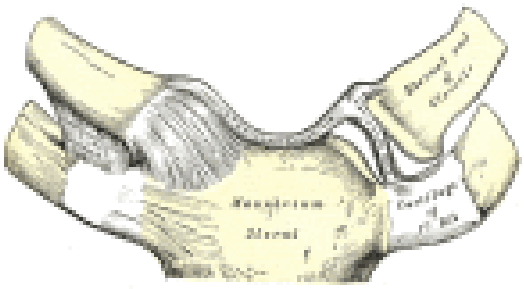


Figure 6:Sterno-clavicular joint.

2)**The Sternoclavicular joint:**

The joint has a saddle-like shape. The synovium lines the sternoclavicular (SC) joint. serves as a skeletal link between both the skeleton systems - the Appendicular and the Axial Skeleton. The manubrium of the sternum forms a joint with the clavicle.

3)**The Acromio-clavicular joint:**

It is a plane freely mobile synovial joint. It is the uniting structure between the clavicle and acromial process.

Figure 7:Acromio-clavicular joint.

4)**The scapulo-thoracic joint:**

It is a fictitious joint but it is a sliding junction between the deeper aspect of the rib cage and scapula. Movements along this plane is controlled and stabilized through variety of muscles allowing for the required positioning of the glenoid joint to assist in the functions of shoulder.

As the shoulder joint at the expense of joint stability has a tremendous range of motion. It is susceptible to injury. To prevent this Glenohumeral instability is dependent on several anatomical and biomechanical factors:

- Static Restraints-
    1. Negative Intra-Articular pressure
    2. Fibrous capsule
    3. Glenoid Labrum
    4. Articular version and congruity
    5. Glenohumeral ligaments
- Dynamic Restraints-
    1. Rotator-Cuff muscles
    2. Biceps -Long head
    3. Periscapular muscles

Glenoid-labrum:

The scapula's glenoid hollow is surrounded by a thick triangular fibro-cartilaginous border called the Glenoid Labrum.

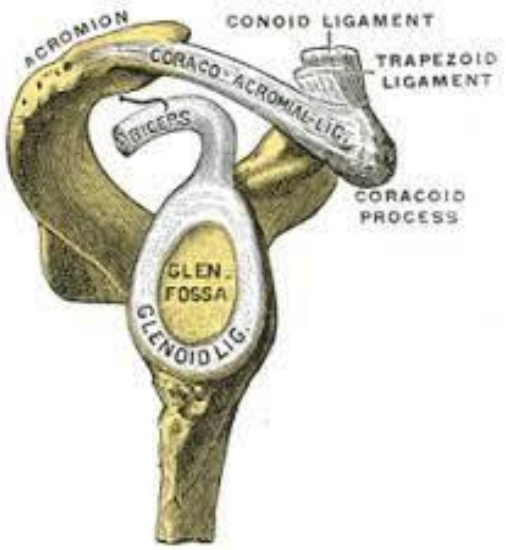


Figure 8:Glenoid Labarum

It varies in thickness and dimension. Superiorly, it combines with the bicep's tendon. In addition to protecting the bone, it builds the joint cavity, giving the articulation of the humerus a deeper socket and increasing its stability.

Fibrouscapsule:

The gleno-humeral joint is encompassed by a fibrous sheath. Bound medially to the glenoid and blends superiorly to the tendon of LHB, and it joins laterally to the humeral neck. The biceps-brachi and rotator cuff muscles link to the capsule. The rotator interval is an exposed capsule region that forms a triangle.

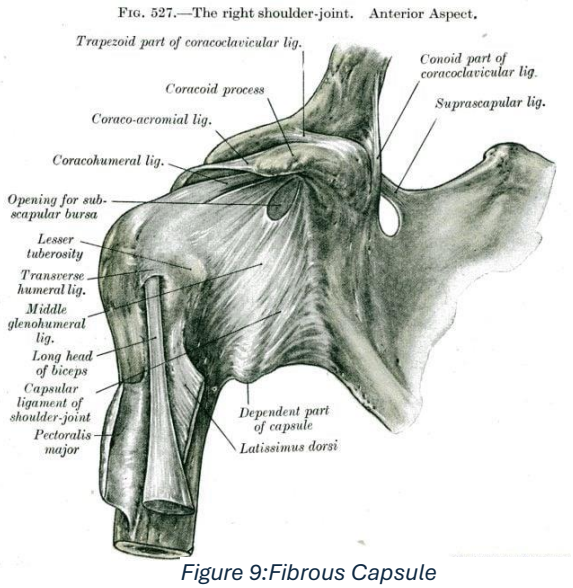


Figure 9:Fibrous Capsule

Ligaments:

The glenohumeral ligament

The fiberous capsule is supported anteriorly and inferiorly by the glenohumeral ligaments. When compared to other ligaments in the body these ligaments have a decreased tensile strength.

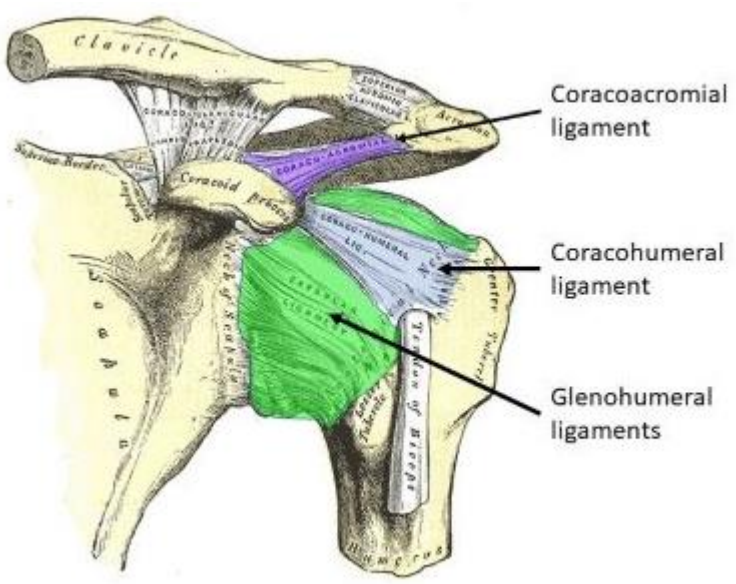


Figure 10:Ligaments around shoulder.

There are three components to the glenohumeral ligaments.

Superior-glenohumeral ligaments (SGHL) - Together with the Coraco-Humeral ligament, the SGHL (which originate from the LHB and attach to the LT of the humerus), stops the inferior displacement of the humerus.

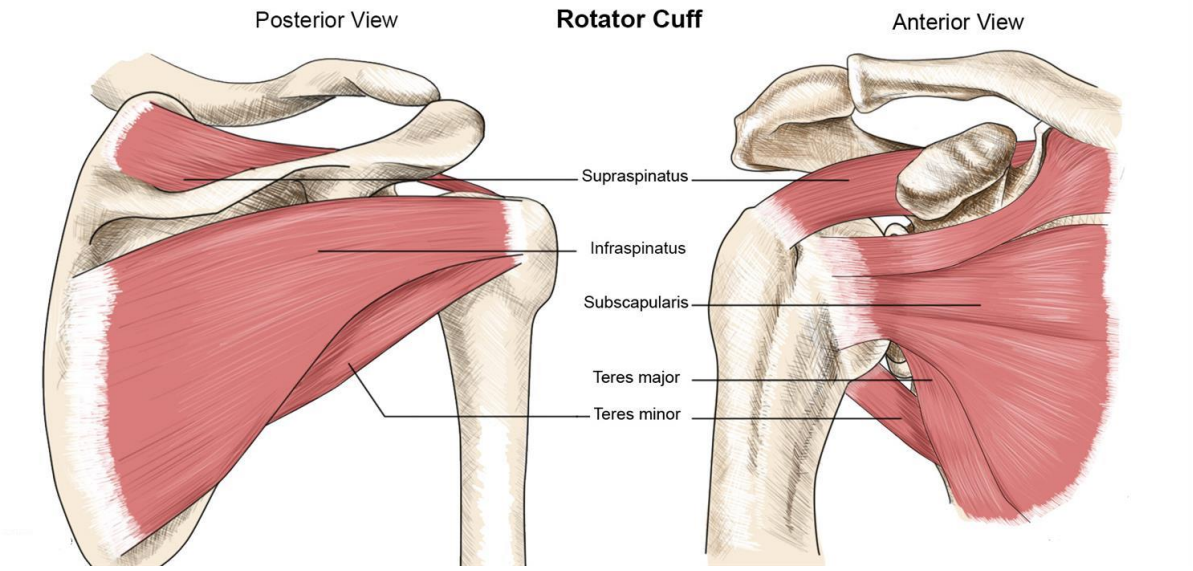
Middle-glenohumeral ligament (MGHL) provides anterior stability to the shoulder along with the Subscapularis Tendon. MGHL(Middle-glenohumeral ligament) emerges from the glenoid(anterior aspect) and inserts into the LT(Lesser Tubercle) of the humerus.

Inferior-glenohumeral ligament (IGHL) stabilizes shoulder statically. Inserting into the capsule from the glenoid labrum's inferior side.

Coracohumeral ligament: This ligament, which resembles a tunnel, joins the fibrous capsule that the long head of the Biceps travels through after extending from the lateral side of the Coracoid Process.

Dynamic restraints

MUSCLES :



Muscle	Origin	Insertion	Action	Innervation
Supraspinatus	Supraspinous fossa of scapula	Greater tubercle of humerus	Abduction of arm	Suprascapular
Infraspinatus	Infraspinous fossa of scapula	Greater tubercle of humerus	Lat rotation of arm	Suprascapular
Teres Minor	Lateral border of scapula	Greater tubercle of humerus	Lat rotation of arm	Axillary
Subscapularis	Subscapular fossa of scapula	Lesser tubercle of humerus	Med rotation of arm	Subscapular

Figure 11:Rotator cuff muscles

Deltoid Muscle

It is a multipennate muscle (The anterior & posterior portions are unipennate, while the lateral region is multipennate. Together, these 3 parts form a triangular muscle.) Which is acts as stabilizer of the shoulder, this muscle prevents inferior glenohumeral joint displacement while completely adducted and bearing a heavy load, as in deadlift exercises. Deltoid muscle is overworked and results in chronic pain in subjects with injuries to the shoulder (Rotator Cuff Muscles).

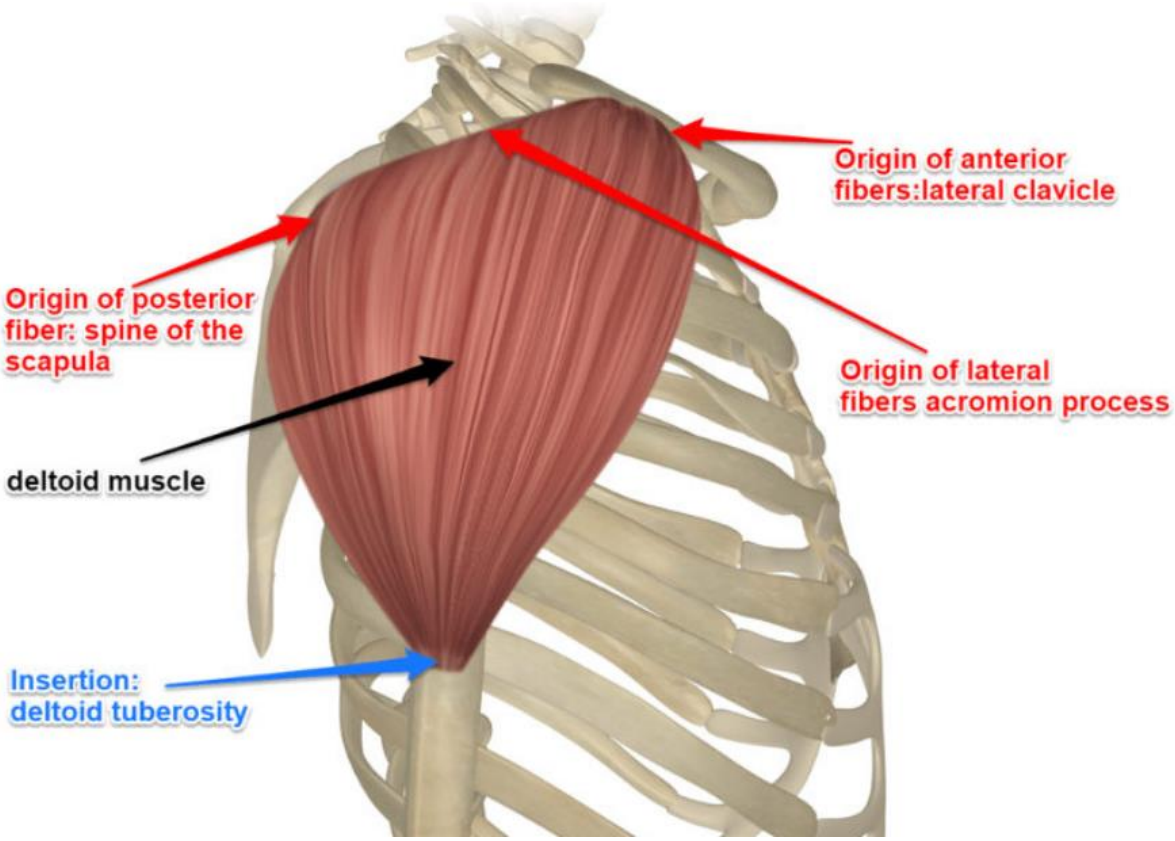


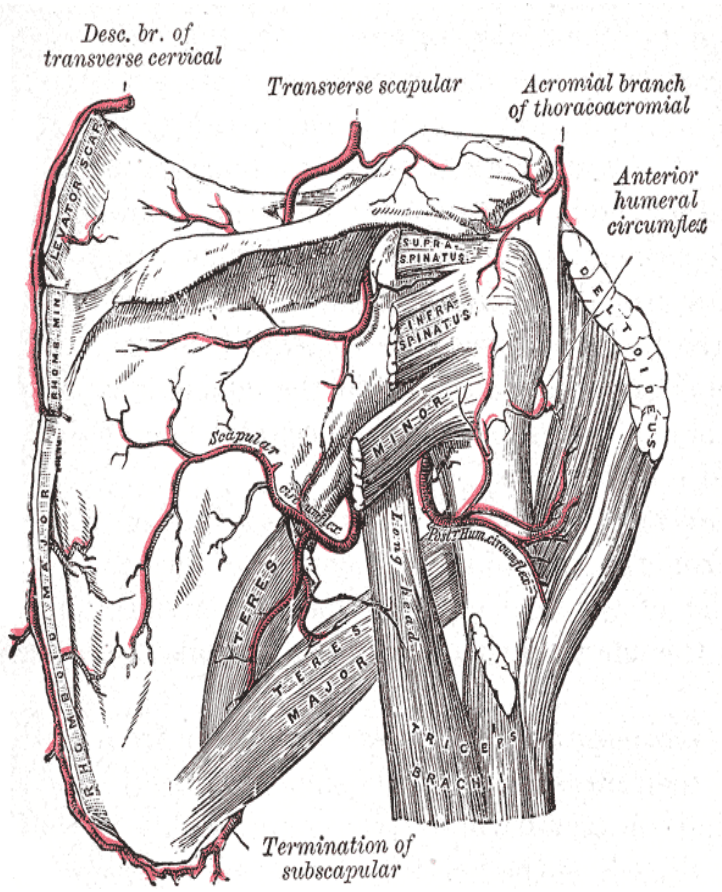
Figure 12:Deltoid muscle.

Long head of Biceps(LHB): The LHB depresses the humeral head and gives the shoulder dynamic support. It can result in SLAP rips and has a variety of origins, including weak linkages created periodically by the superior labrum. Intra-articular LHBT injury is defined as damage that takes place at the origin of the LHBT or inside the rotator interval. SLAP rips have the potential to weaken or puncture the biceps tendon. Numerous writers have observed a link between rotator cuff degeneration, instability, and persistent pain and the aberrant development of LHBT (9,10).

Circulation:

Posterior branch of circumflex humeral artery and sub-scapular and supra-scapular arteries make up the majority of the rotator cuff's blood supply.

The cervical base is the point at which the supra-scapular artery arises. It comes from the trunk of the thyrocervical artery. As it enters the postero-scapular region superior to the supra-scapular foramina, it supplies the supra-spinatus and infra-spinatus muscles (nerve passes from foramina).



Normal Range of Movements at Shoulder Joint –

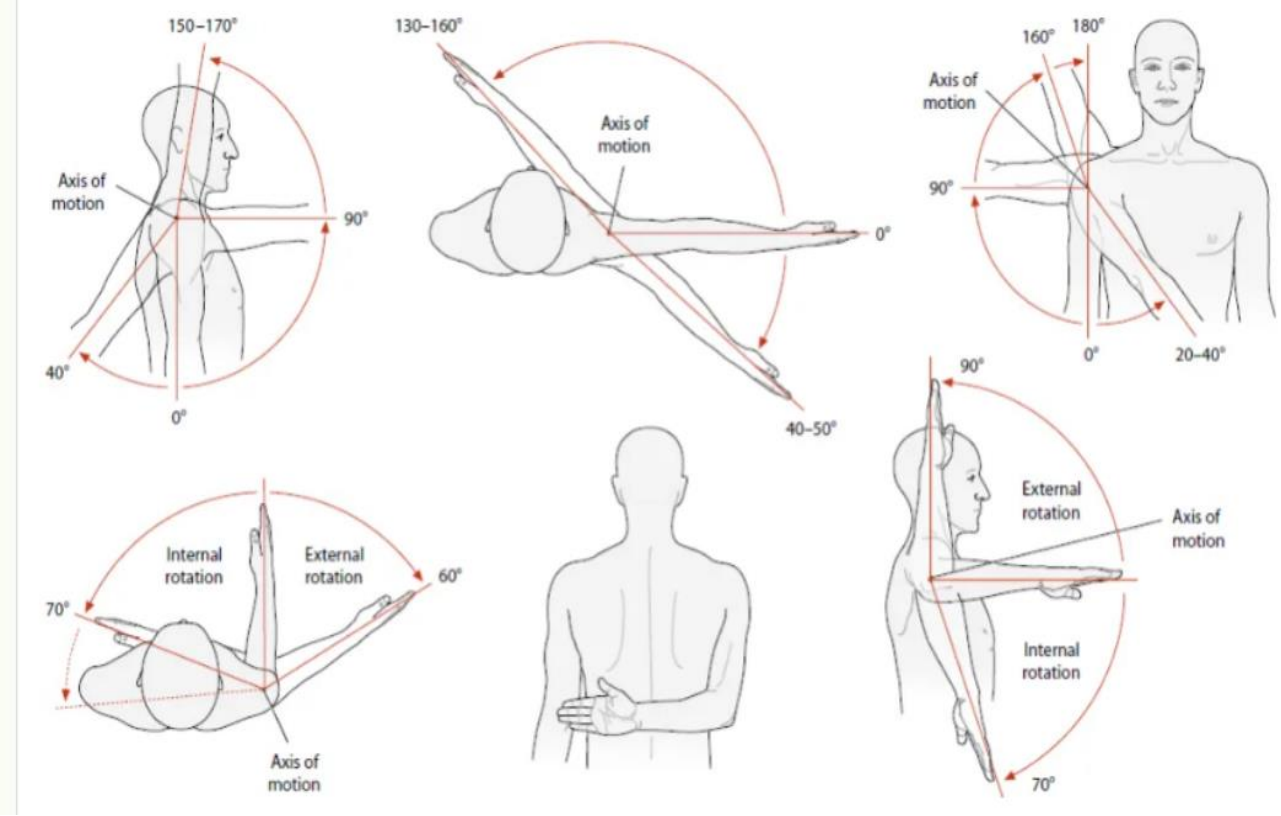


Figure 13: Range of motion of shoulder along different axes.

Biomechanics of shoulder

Compared with the hip joint, there is a trade of stability for movements. As the optimum positioning of the hand is required for the fine motor functions. Meanwhile scapular motion contributes mostly to abduction in the range from 80 to 140°. The compressing humeral head on glenoid-cavity stabilizing gleno-humeral-joint is done primarily by the rotator-cuff.

Muscles of the rotator cuff complex undergo contraction during the shoulder ROM, achieving both mobility and stability in the movements of the shoulder. Taking origin at the scapula, the 4 muscles are inserted around the head of humerus. There is increased scope for laxity in the inferior unprotected part of the shoulder, accounting to most of such subluxations.

As the tendon of the rotator cuff complex merges with the joint capsule and forms the musculo tendinous cuff offering support over the posterior, superior and anterior parts.

These muscles are independently evaluated during a physical examination based on their unique motions.

1	NEER Test	the elbow should be extended, humerus in internal rotation and the forearm pronated. When the examiner is passively flexing the arm forward	Subacromial impingement
2	HAWKIN'S KENNEDY Test	a passive test, with the examiner positioning the patient's arm at 90° in the scapular plane, the elbow bent to 90°, and the arm taken passively into internal rotation.	Subacromial impingement
3	FULL CAN Test	The arm is flexed to 90°in the scapular plane and the forearm supinated, so externally rotating the shoulder joint (the 'thumbs up position)	supraspinatus
4	EMPTY CAN/JOBE's empty can Test	The arm is flexed to 90°in the scapular plane and the forearm maximally pronated, so internally rotating the shoulder joint (the classical 'thumbs down' position).	supraspinatus
5	GERBER'S lift-off Test	The dorsum of the hand is placed on the sacrum and the patient is asked to take the hand off the back when the examiner maintains a fixed angle of elbow flexion.	subscapularis

Imaging of shoulder joint

1.Plain radiograph

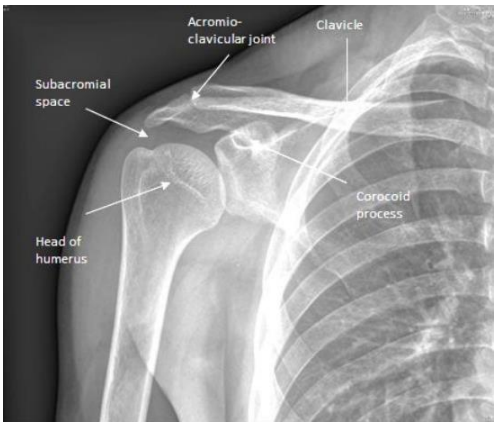


Figure 14:Plain radiograph of shoulder.

As per routine investigations radiographs form the initial mode of imaging study obtained in patients presenting with shoulder pain. Numerus radiographic views have been developed to obtain optimal view of the structures of this highly complex anatomy of shoulder. The disadvantage of radiographs is that soft tissue status cannot be assessed.

2.Magnetic resonance imaging (MRI)

Figure 15:MRI machine.

When it comes to diagnosing rotator cuff disease, MRI is essential.because it is capable of displaying clear pictures of the joint's anatomical structure.

MRI uses powerful magnets to produce strong magnetic fields to align the protons with the field (as hydrogen is the most abundant in the body – Fat and water, hence it is used for imaging purposes). When the patient is in an intense magnetic field, such as an MRI scanner, all of the hydrogen atoms, or proton axis, align. After that, an RF current is pulsed through, stimulating the hydrogen atoms and causing them to spin out of balance.

When the RF source is cut off the excited hydrogen atoms lose their energy to return back to stable state thereby releasing radiowaves. These radiowaves are picked up the sensors. Based on the strength of the signal generated the computer makes a 3D grey scale map.

Then the images are built up. Since different organs of the human body has different composition of water, difference in signal intensity help us to identify the pathology.

To improve the sensitivity of detection of the signals receiver coils are used, which are wrapped around the body part in question.

However, it remains relatively expensive for routine use.

3.Arthroscopy

An important development in the identification and management of shoulder diseases is shoulder arthroscopy. It offers an unobstructed, clear view of the joint.
Arthroscopy requires smaller surgical incisions when compared to traditional arthrotomy and has less muscle manipulation resulting in less discomfort after surgery, faster recovery, and better view of intraarticular anatomy and pathology than open operations.

When diagnosing intraarticular lesions, arthroscopy is considered the gold standard since it allows for direct imaging of the joint.
The patient may be placed in a supine beach chair position or in lateral decubitus during the procedure.
In the lateral decubitus position, the patient rests on their side with their trunk rotated 25° –30° posteriorly to make sure their glenoid, which is supported by straps or another supportive device, is parallel to the floor. The foam traction sleeve that the operating arm is placed inside is fastened to the OT table. To see the subacromial area and the glenohumeral joint during the procedure, the arm is positioned at 45° abduction and 15° flexion. Weights weighing around 5 kg are utilized as traction weights to divert attention from the joint and increase the intra-articular space available for the scope (11).

Figure 17:Intra-op positioning of the patient.

- increased joint distraction, which affords easier access to the inferior aspect of the labrum (the 6-o'clock position)
- increased traction on the capsuloligamentous structures, which can accentuate labral tearing.
- widening of the subacromial space
- less interference by the patient's head on the surgeon during the procedure.

- nonanatomic orientation
- inability to put the shoulder in an abducted and externally rotated position.
- more cumbersome transition to open surgery
- risk of neurapraxia secondary to traction

Figure 16:Advantages and disadvantages of lateral decubitus position.

Patient is positioned on the edge of the operating table in the "beach chair" posture, which leaves the operative shoulder unsupported. To ensure the patient has comfortably flexed their hips and knees, the table is flexed 45–60°. To put the glenohumeral joint in an anatomic position, the back of the operating table is raised until the acromion is at right angle to the floor (11).

- examining the shoulder in an anatomic position
- the ability to easily manipulate the shoulder intraoperatively.
- easier transition to open surgery if necessary.

- limited access to the inferior aspect of the labrum in the treatment of glenohumeral instability
- potential interference of the patient's head with surgical instruments
- increased risk of cardiovascular complications such as hypotension

Figure 18:Advantages and disadvantages of beach chair position.

Overall, there is no benefit to utilizing one posture over another in terms of clinical outcomes or costs. It comes down to the operating surgeons choice and comfort.

GALLERY

IMAGES OF MRI VS ARTHROSCOPY

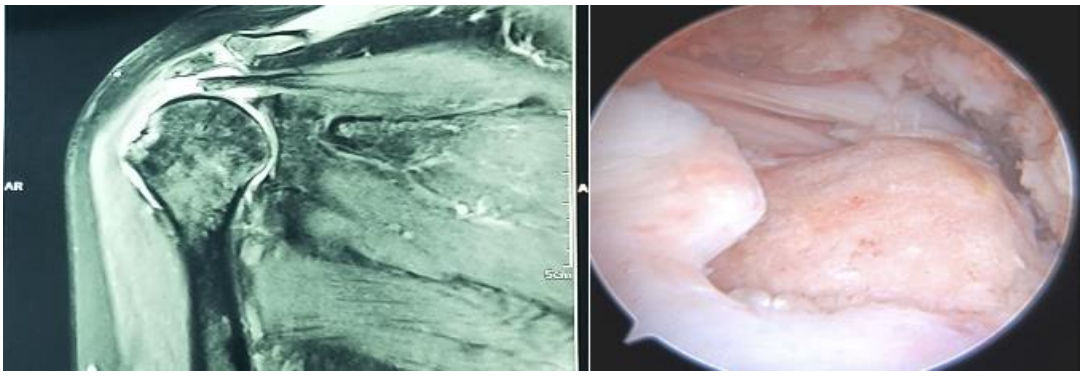


Figure 19:Complete tear of supraspinatus.

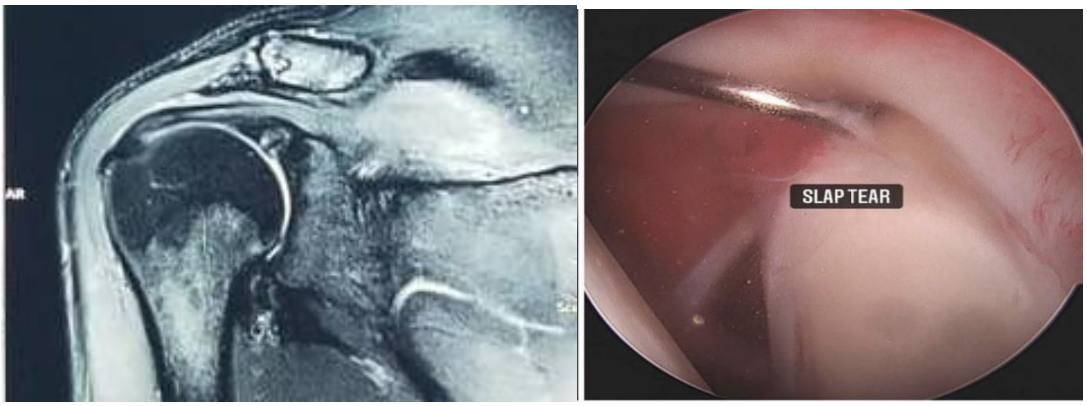


Figure 20:SLAP tear.

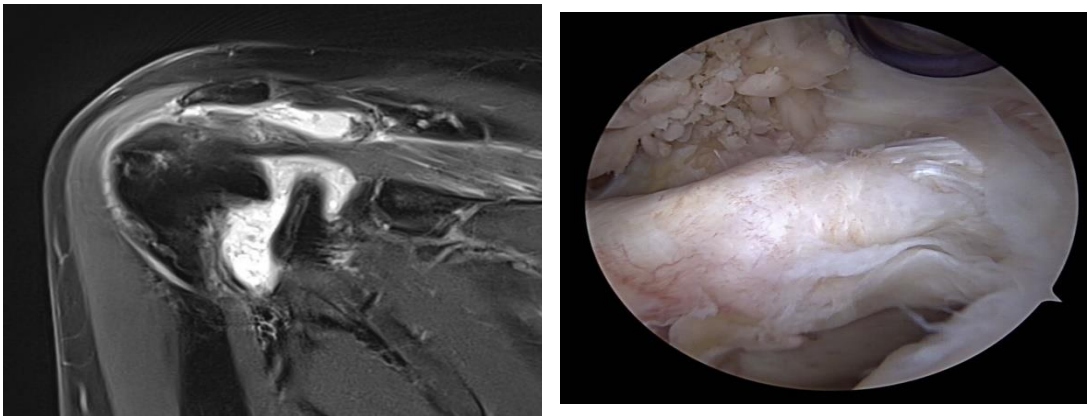
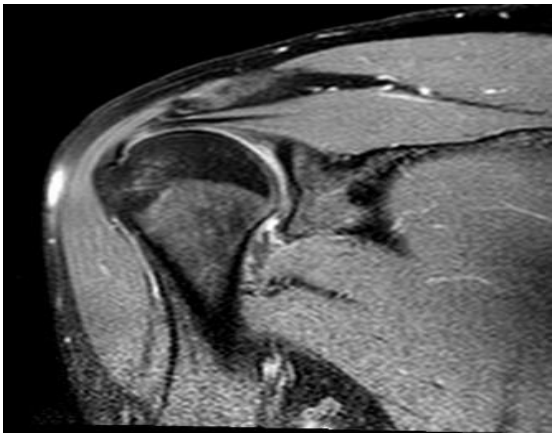


Figure 21:Subscapularis tear.



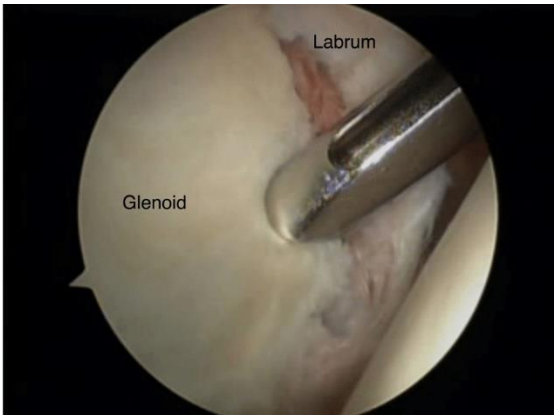
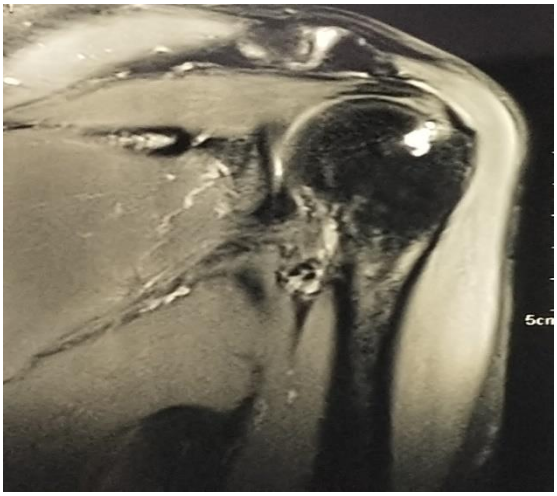


Figure 22:Bankarts lesion.



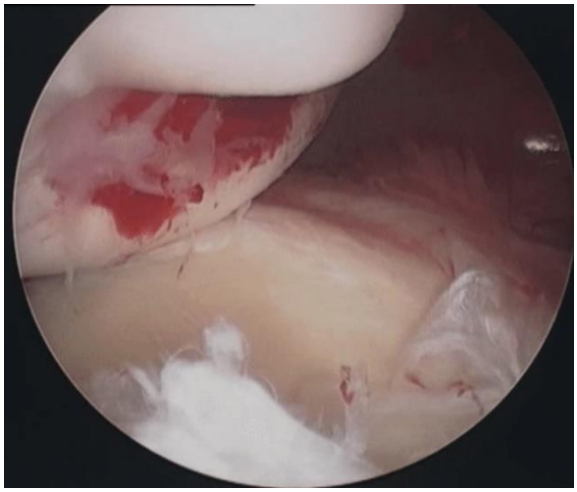


Figure 23:Hill-Sachs lesion.

REVIEW OF LITERATURE

Since the physical signs of shoulder pathologies are poorly reproducible, the arrival to accurate diagnosis is difficult and is usually ambiguous, therefore along with the clinical examination, many modalities of imaging can be used in order to identify the underlying pathology to determine the path of treatment. After thorough clinical examination, initial first line of imaging would be plain radiography, the disadvantage being inability to identify soft tissue pathology. Hence arthrography, USG and MRI imaging is needed to arrive at the accurate diagnosis.

The advantages of Magnetic Resonance Imaging are mainly its non-invasive, provides a superior soft tissue imaging when compared to the other imaging modalities. Since the MRI uses strong magnets, it is contraindicated in patients who have orthopaedic implants, pacemakers, and cochlear implants as they are metallic and may interact with the strong magnetic field produced by the MRI machine. Sedation might be needed for children or patients with claustrophobia as the patient must lie perfectly still for the entire duration of the scans.

The accuracy of MRI in detecting a lesion depends on the reader as well as operator but its effectiveness is decided by the nature of underlying pathologic abnormality which helps us come to a diagnosis.

In literature, there are some inconsistencies regarding the accuracy of MRI in shoulder pathology identification. According to a few studies, MRI has been observed to be very accurate for identifying rotator cuff tears & Bankarts lesions but not so precise in detecting SLAP lesions. In cases of shoulder pathology where clinical examination is ambiguous, studies show MRI cannot be depended upon for definitive diagnosis.

There are certain benefits of repairing a tear in the rotator cuff which include pain alleviation, increased functionality, and patient satisfaction(12). Open, micro-open, and arthroscopic surgery are frequently used to repair torn rotator cuffs. Therefore, it is recommended that individuals with a significant rotator cuff tear and significantly decreased shoulder functioning be admitted to the hospital and have surgery.

The major cause of shoulder pain in patients above forty years is rotator cuff impingement and tears(13). With ageing, studies have shown a statistically significant rise in frequency and loss of the muscle-tendon unit due to degeneration. Prevalence of rotator cuff tear range is 5% to 40%, and majority of sore shoulders around 30–70% is due to rotator cuff diseases. Due to some injuries being asymptomatic, a clinical diagnosis is not certain(14).

Different studies have found varying prevalent rates and epidemiological characteristics of rotator cuff injuries. Tempelhof et al and Schibany et al, were of the opinion that full thickness tears were more common in 411 and 212 participants, respectively, at 23% and 6% (15,16).

ROTATOR CUFF TEAR

It is the group of muscles around the shoulder which help in the movements of the shoulder and provides stability to it.

In a study done by Xingzhen hu, it has been observed it is vital to assess and treat any shoulder pathology, because rotator cuff alone can cause 50% of chronic pain and disability(17)

Rotator cuff tears pathophysiology has traditionally been split into extrinsic (overuse, chronic impingement syndrome, among multifactorial etiologies) and intrinsic (degeneration, micro-trauma, apoptotic hypothesis, with extracellular matrix modifications) etiologies. Supraspinatus is made up of two components. Each of the two anterior and posterior components of the muscle is further split into three parts: superficial, medium, and deep(18). The anterior segment of the supraspinatus muscle presents as larger and tubular, displaying a bipennate structure that enables it to exert greater contractile forces compared to the smaller posterior segment. This discrepancy in contractile force is partly due to the anterior segment's longer intramuscular tendon. Conversely, the posterior portion of the supraspinatus is smaller in size, characterized by a unipennate configuration, and possesses a wider, flatter tendon, decreasing the contractile forces as a consequence. The tendon cross-sectional area ratio between the anterior and posterior segments is around 0.9:1, despite the anterior segment being nearly twice as large as the posterior portion. Due to the difference in tendon size and the discrepancy in contractile stress, the anterior portion is more susceptible to tendon and myotendinous injury(19,20).

As observed by Dinnes(21) in their study “the clinical examination preceeds the diagnosis of the rotator cuff has shown a sensitivity of 90% meanwhile a specificity of only 54%. In sharp contrast when MRI is used to diagnose a rotator cuff tear, this exhibits sensitivity of 89% and a specificity of 93%” Fukuda et al(22).

Asrthi et al upon investigating MRI accuracy for rotator cuff pathology “reported a sensitivity of 96.88% and specificity of 92.86% and a diagnostic accuracy of 95%”(23).

The main limiting factor of an MRI, for a surgeon who is relying on the report to make a surgical decision, depends upon whether it is a partial thickness tear or a full thickness tear.

It was reported a 7.2% incidence of solely intrasubstance tears in the supraspinatus. This raises an issue as these tears are not picked up during routine arthroscopy, thereby leading to a decrease in MRI accuracy. This is particularly true when these do not communicate with the joint, thereby they cannot be visualized. This holds a important role in assessing the reliability of MRI.

Consequently, surgical interventions based on the diagnosis of intrasubstance tears may not yield beneficial results for the patient.

Arthroscopy also has a significant mechanical edge over MRI. While MRI captures images in a static position, arthroscopy allows for manipulation of the arm into different positions. This flexibility enables dynamic assessment, and the use of an intraarticular probe can reveal structural abnormalities that might remain undetected by MRI alone.

Lambert et al(24) in their study found that “when 3T MRI is used for diagnosis rotator cuff tear which require surgery, the PPV(positive predictive value) is 100%” which shows high reliability on the MRI but another similar study by Biswas, Sondipon & Kanodia et al (25), “Percentage of false negative diagnosis by MRI when compared to clinical examination and arthroscopy was found to be 16.67%”.

This discrepancy could be due to the quality of the MRI or the interpretation of the MRI (observer variation). This affects the surgeon when planning for the management of a case as certain pathologies might be missed on MRI which requires conservative/surgical fixation(25,26). It was discovered that MRI is quite specific but still lesions may tend to go unnoticed because of mechanical constraints in identifying undersurface tears, particularly delaminating tears and the supraspinatus tendon's unique oblique orientation causes further difficulties in identification(27).

SLAP TEARS (SUPERIOR LABRUM ANTERIOR AND POSTERIOR)

In general, superior labral tears have been detected with high accuracy in MRI, but with low to moderate sensitivity as some have reported, (28–30) Comparatively, less data exists on subclassification of labral tears. Reports show low to moderate accuracy characterizing SLAP 3 and SLAP 4 lesions.

When the pectoralis minor tendon joins to the glenohumeral joint capsule, its abnormal insertion generates additional perplexity. It possesses another entity that is similar to the intraarticular long head of bicep's tendon longitudinal split tear these causes confusion while reporting the scans.

The coracohumeral ligament is absent when the pectoralis minor tendon passes across the coracoid process. The frequency of SLAP tears are higher(31).

Depending on whether the lesion is an intrasubstance injury only or is detached from the glenoid rim, surgical treatment of the tear is decided. SLAP 3 tears, because they are intrasubstance lesions, require surgical debridement only, whereas SLAP 4 lesions require reattachment with suture anchors (28). Accurate identification of these lesions has lasting clinical consequences.

Reuss et al's study implied "the possible reasons that SLAP lesions were either missed or mischaracterized due to the abnormalities being very small, leading to inadequate spatial resolution". This may result in them to go undetected(30).

BANKARTS LESION

MRI is quite specific and sensitive in identifying Bankart's tear. Even though MRI had a very high sensitivity, it was more specific than sensitive in identifying Bankart's tear. In their research, Eric T. Torstensen and Robert M. Hollinshead(32) discovered that “MRI had a 62% accuracy rate, 73% sensitivity, and 58% specificity in identifying labral injuries”. Meanwhile, OR Momenzadeh(33) discovered that “MRI had a low sensitivity and moderate specificity in identifying Bankart's tear.”

Joshua M pollster et al, attributed the low sensitivity of MRI when detecting the bankart’s lesion to two main factors(34) “Wide variation in the type and position of a Bankarts lesion and the Close proximity and abutment of labrum to capsule and cortical bone which have same signal intensity makes it difficult to distinguish them from one another.”

HILL SACHS LESION

Using MR arthrography, cartilage lesions are difficult to diagnose. Bhatnagar et al (35) showed a “Sensitivity for humeral-sided articular cartilage abnormalities ranged from 53% to 100% and specificity ranged from 51% to 87%.”.

CONSERVATIVE

Physical- Therapy
Anti-inflammatory meds
Lifestyle Modifications

SURGICAL

-Complete Rotator Cuff Tear
- Repeated Dislocation
- Significant Pain with Dysfunction
- Failure of Non-surgical Management

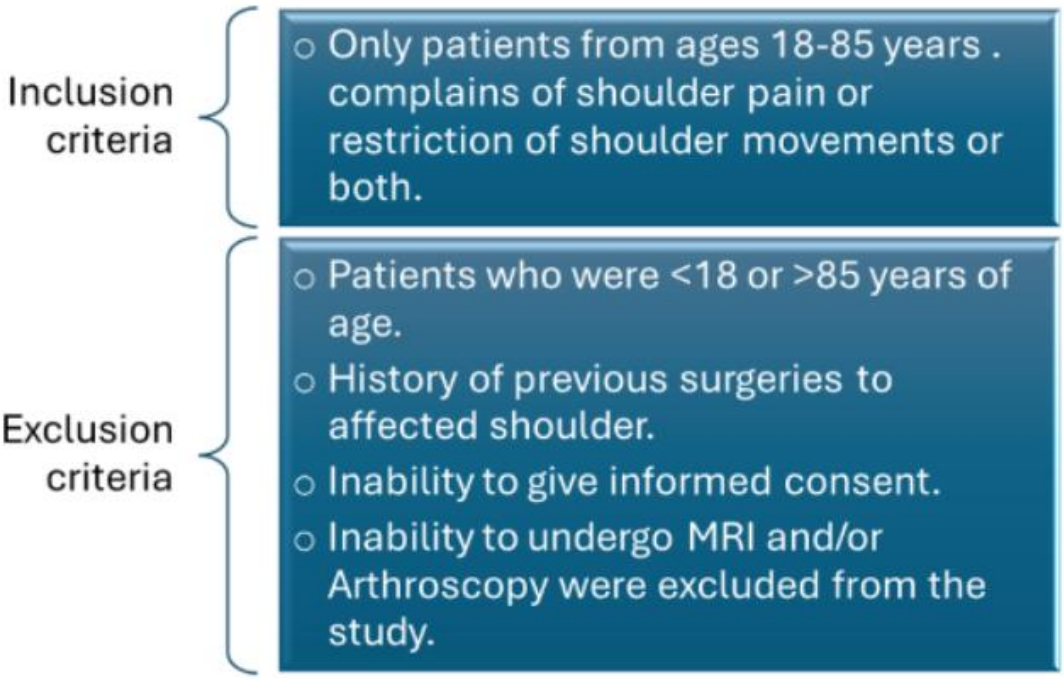
Additionally, before deciding the final course of treatment, patient’s functional requirements, existing co morbidities and the financial burden of the treatment has be to considered.

METHODOLOGY

This is a hospital based cross-sectional study, of 12 months duration. Sixty-one patients, between eighteen to eighty yers of age, presenting to the orthopaedic outpatient department of the "KLE DR PRABHAKAR KORE HOSPITAL AND MRC, BELAGAVI" from 15th June 2022 to 14th June 2023 with shoulder pain or instability or with clinical signs of impingement or tear were included in the study.

- A total of 61 patients were part of this study who were examined in detail and necessary investigations were performed.
- The patients were duly informed regarding the study and those willing to participate were noted.
- Written informed consent was taken.
- Patients were then asked to get MRI of the affected shoulder.
- If both clinically and radiologically indicated, patient was counselled for arthroscopic intervention.
- Patients willing for arthroscopic intervention, further fitness and investigations were performed and consent for surgery taken.
- Intraoperative findings were noted and documented.
- The data of all investigations and intraoperative findings were documented, compiled and analysed.

Selection Criteria for the study were as follows:



The MRI findings were placed into one the four categories after arthroscopic evaluation.

True positive (TP): MRI diagnosis of tear, confirmed on arthroscopic evaluation.	False positive (FP): MRI showed a tear, but arthroscopy was negative
False negative (FN): If MRI images were negative but arthroscopy showed a tear	True negative (TN): MRI diagnosis of no tear was confirmed on arthroscopy.

RESULTS

All observations of shoulder pathology were statistically analysed using SPSS (Statistical package for social science). There were 61 patients considered as part of the study. Clinical parameters such as Age, Co-morbidities and medications were documented.

Statistically significant when p<0.5

TABLE 1 – DISTRIBUTION OF SUBJECTS AS PER THEIR AGE

AGE	NUMBER	MEAN ± S.D
>20	1	20 ± 0
21 – 40	12	33.08 ± 6.87
41 – 60	32	51.06 ± 5.46
61 – 80	16	65.87 ± 3.34
TOTAL	61	P<0.00001

P value is <0.00001.

The mean age of subjects in the age group of <20, 21-40, 41-60 & 61-80 was found to be 20 ± 0, 33.08 ± 6.87, 51.06 ± 5.46 and 65.87 ± 3.34 respectively, which was found to be statistically significant

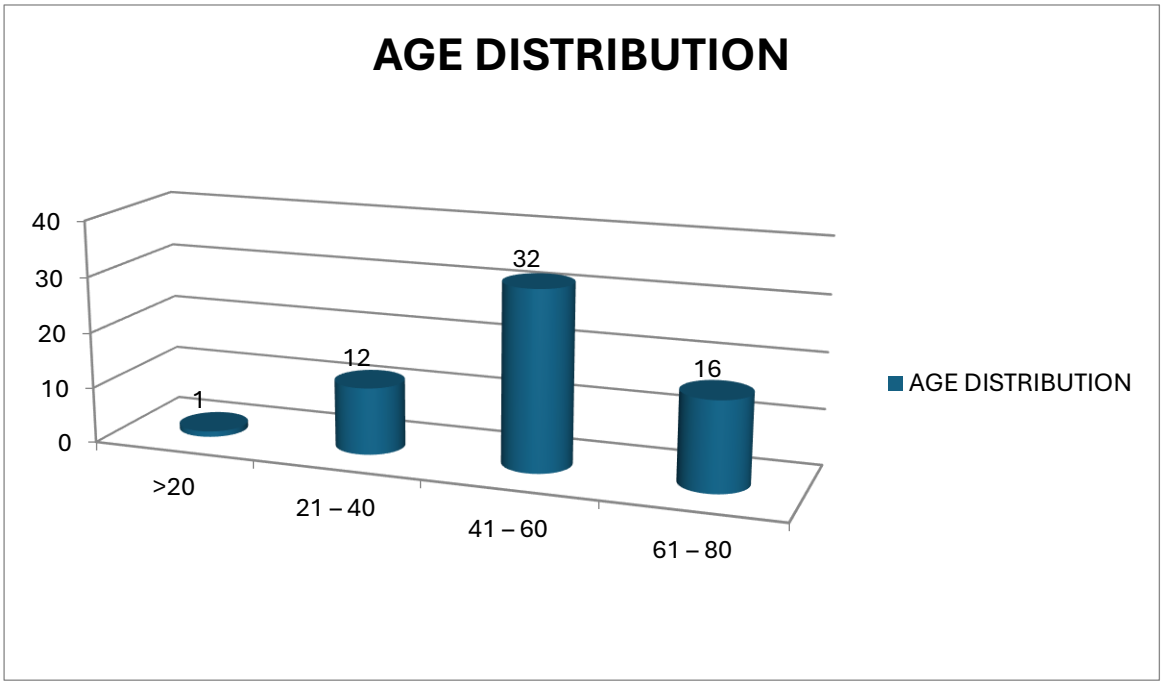

AGE DISTRIBUTION
40
30
20
10
0
1
12
32
16
>20
21 – 40
41 – 60
61 – 80
AGE DISTRIBUTION

TABLE 2 – DISTRIBUTION OF SUBJECTS AS PER THEIR GENDER

GENDER	NUMBER	PERCENTAGE
MALE	33	54.10%
FEMALE	28	45.90%
TOTAL	61	100%

The study consisted of 33 (54.10%) male and 28 (45.90%) female subjects respectively.

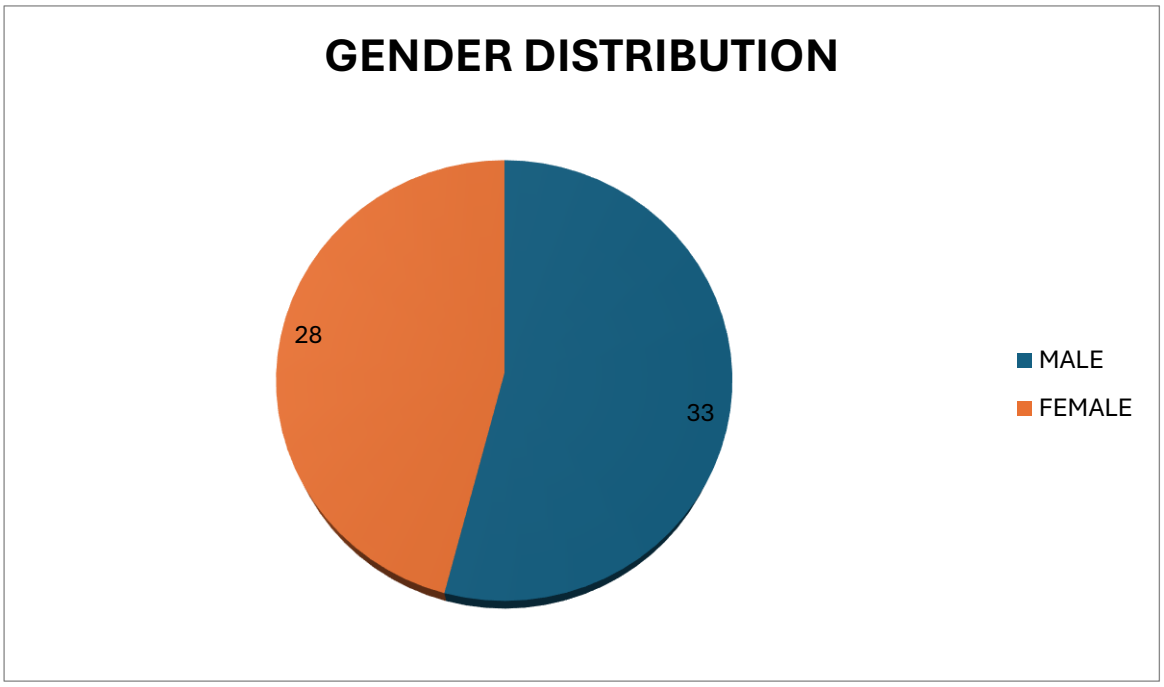
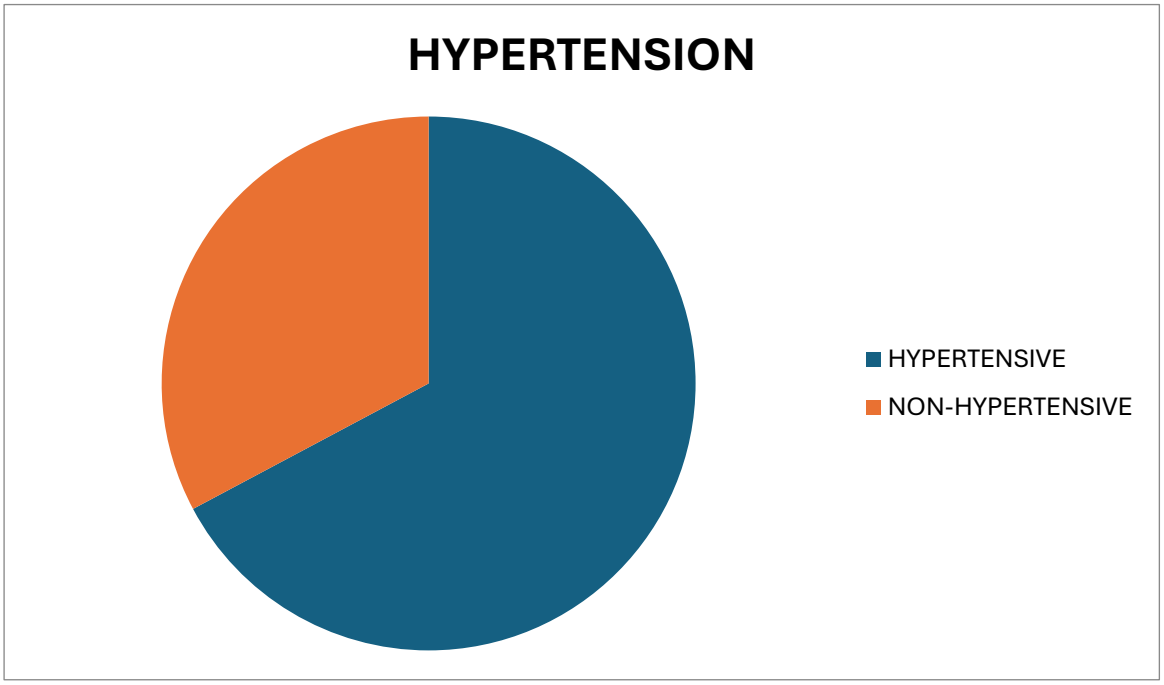


TABLE 3 – DISTRIBUTION OF SUBJECTS DEPENDING ON THE TYPE OF COMORBIDITIES

A. HYPERTENSION

HYPERTENSION	NUMBER	PERCENTAGE
YES	41	67.21%
NO	20	32.79%
TOTAL	61	100%

The study consisted of 41 (67.21%) hypertensive subjects respectively.



B. DIABETES MELLITUS

DIABETES MELLITUS	NUMBER	PERCENTAGE
YES	37	60.66%
NO	24	39.34%
TOTAL	61	100%

The study consisted of 37 (60.66%) diabetes mellitus subjects respectively.

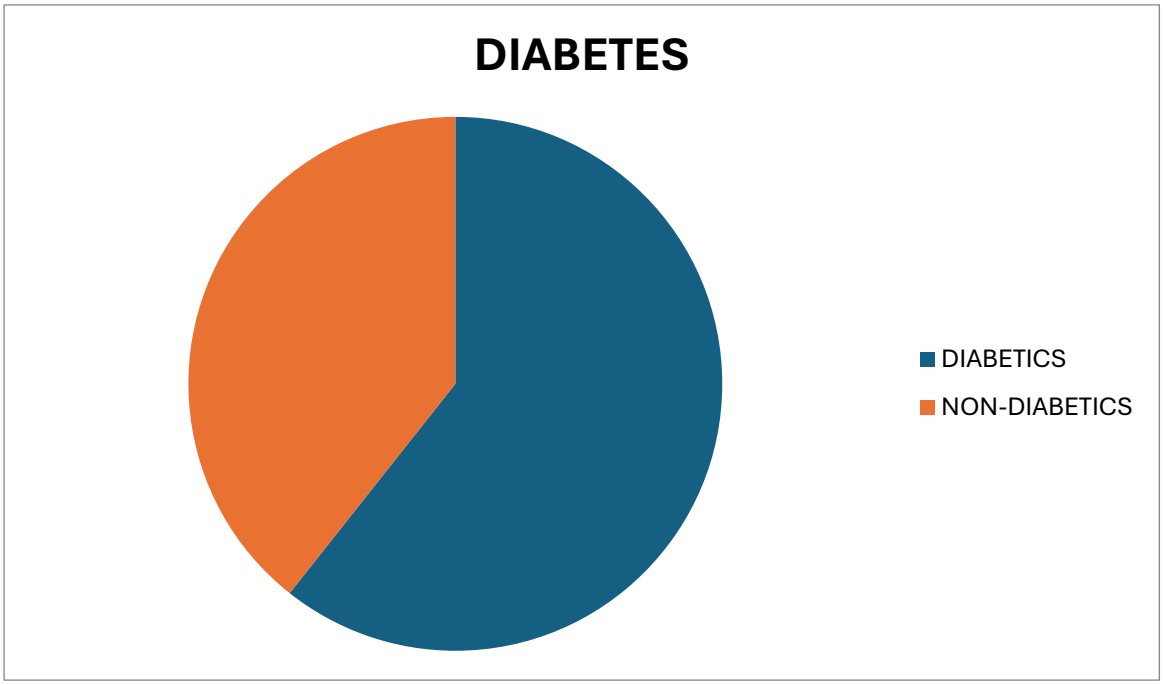


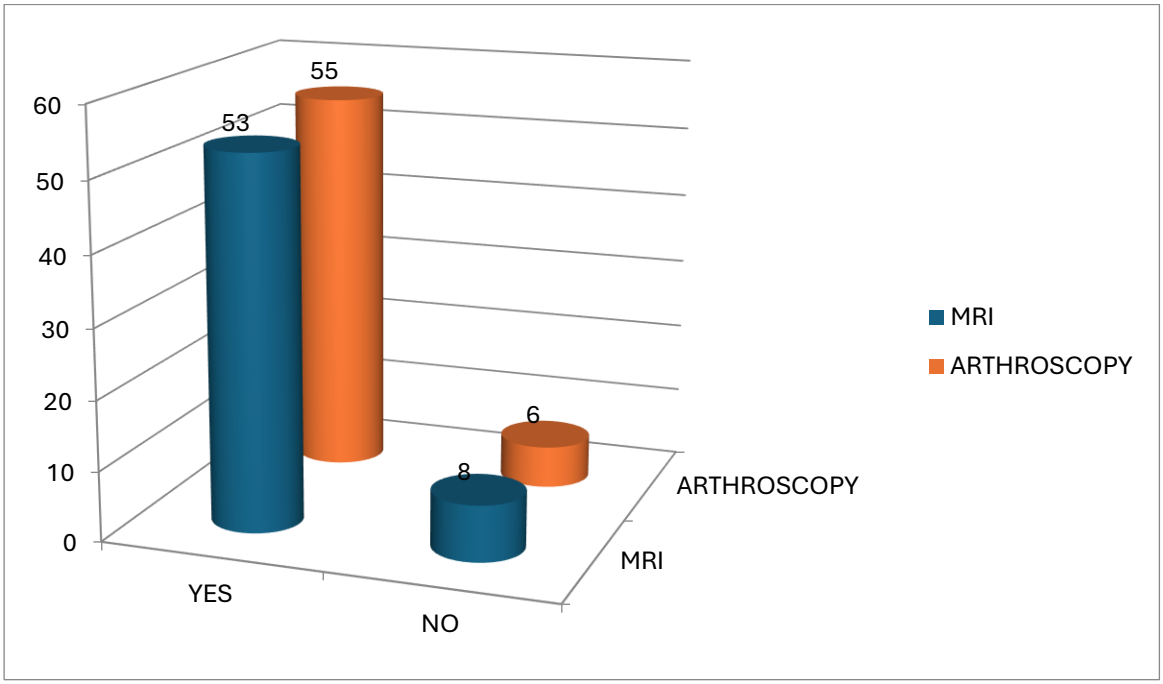
TABLE 4 – PRESENCE OR ABSENCE OF DEFECTS DEPENDING ON MRI & ARTHROSCOPY

A. ROTATOR CUFF DEFECTS

PRESENCE OR ABSENCE OF ROTATOR CUFF DEFECTS	MRI	ARTHROSCOPY
YES	53	55
NO	8	6
	P = 0.569959	

P value is 0.569959.

Study showed 53 and 55 subjects by MRI & Arthroscopy for rotator cuff pathologies, which was found to be statistically insignificant.

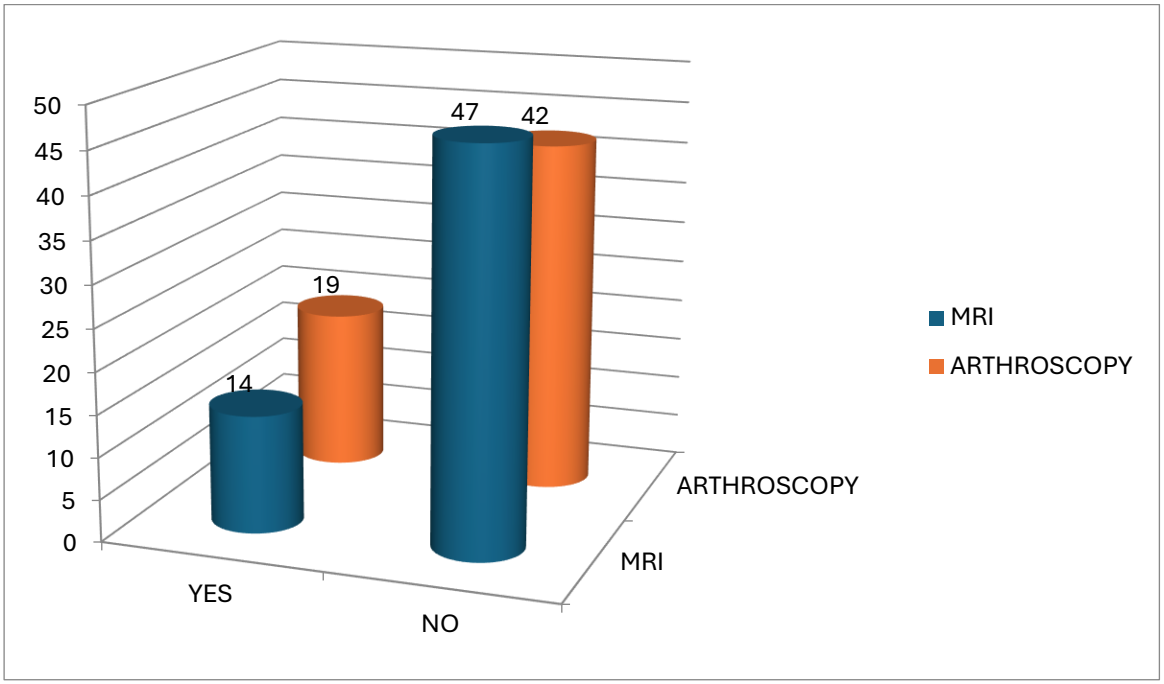


B. SLAP TEAR

PRESENCE OR ABSENCE OF SLAP TEAR	MRI	ARTHROSCOPY
YES	14	19
NO	47	42
	P = 0.308176	

P value is 0.308176.

Study showed 14 and 19 subjects by MRI & Arthroscopy for slap tear, which was found to be statistically insignificant.

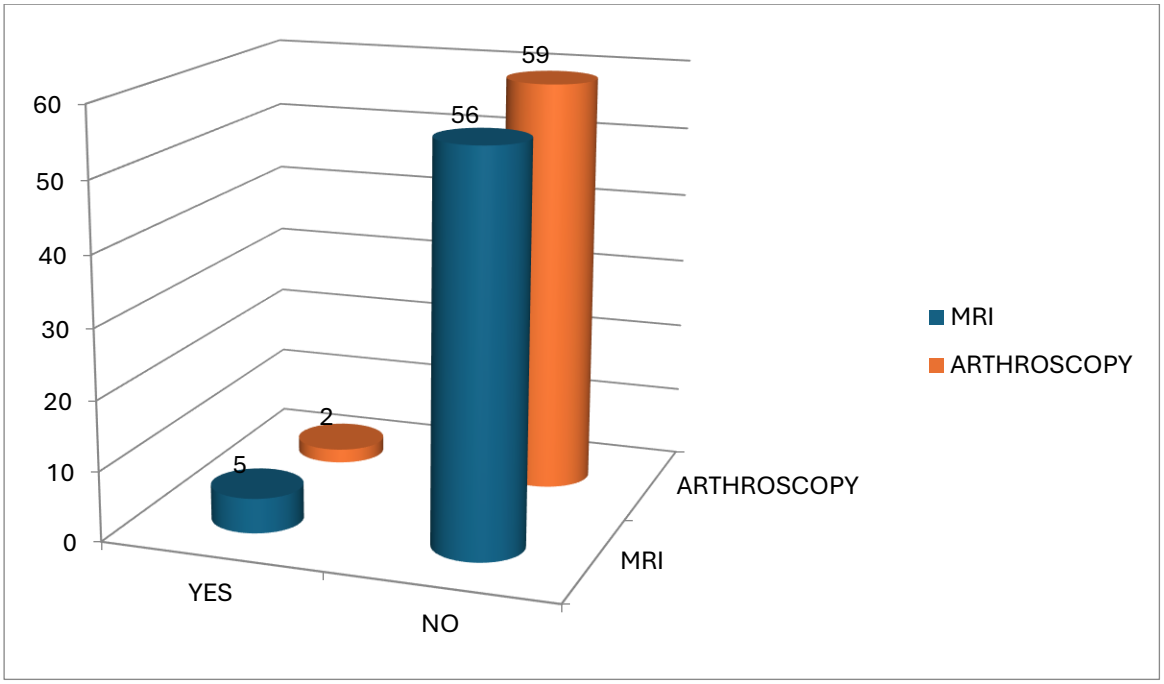


C. BANKARTS LESION

PRESENCE OR ABSENCE OF BANKARTS LESION	MRI	ARTHROSCOPY
YES	5	2
NO	56	59
	P = 0.24285	

P value is 0.24285.

Study showed 5 and 2 subjects by MRI & Arthroscopy for BANKARTS LESION, which was found to be statistically insignificant.



D. HILL SACHS LESION

PRESENCE OR ABSENCE OF HILL SACHS LESION	MRI	ARTHROSCOPY
YES	4	4
NO	57	57
	P = 1	

P value is 1.

Study showed 4 and 4 subjects by MRI & Arthroscopy for HILL SACHS LESION, which was found to be statistically insignificant.

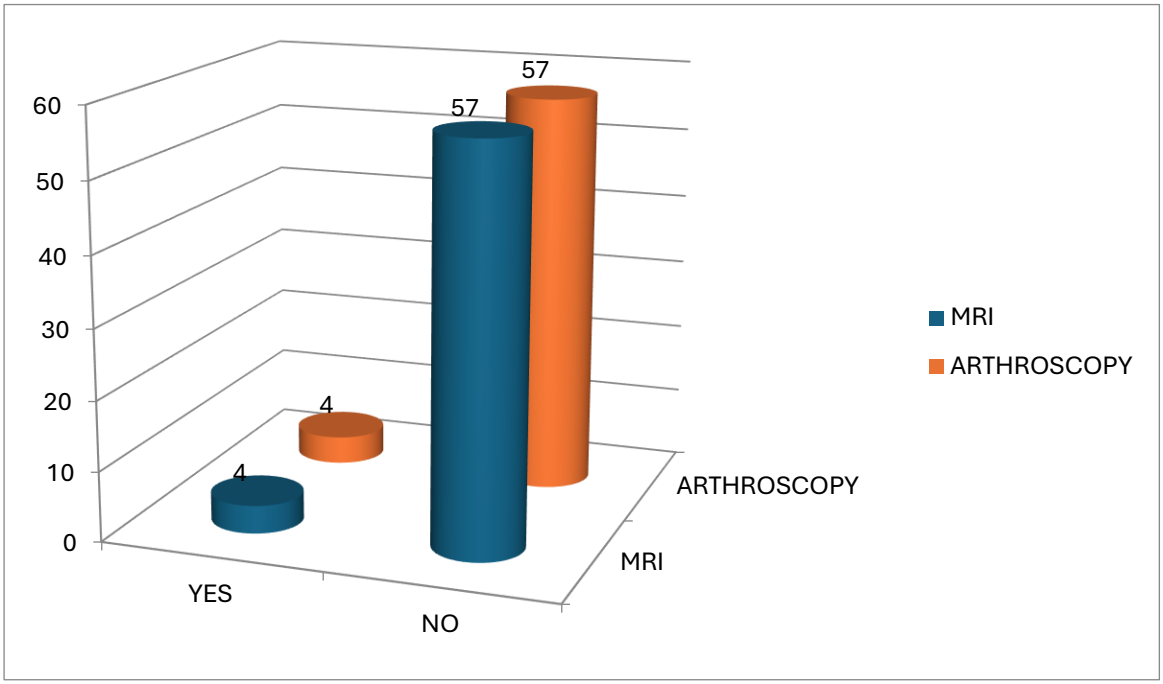


TABLE 5 – SENSITIVITY, SPECIFICITY, NPV & PPV OF ROTATOR CUFF PATHOLOGY

ROTATOR CUFF TEAR		ARTHROSCOPY		
		POSITIVE	**NEGATIVE**	**TOTAL**
MRI	**POSITIVE**	49	4	53
	NEGATIVE	2	6	8
	TOTAL	51	10	61

- SENSITIVITY – 96.08%
- SPECIFICITY – 60.0%
- PPV – 92.45%
- NPV –75%

For rotator cuff, we found sensitivity, specificity, PPV & NPV of 96.08%, 60.0%, 92.45% and 75% respectively.

*PPV – POSITIVE PREDICTIVE VALUE

NPV – NEGATIVE PREDICTIVE VALUE

TABLE 6 – SENSITIVITY, SPECIFICITY, NPV & PPV OF SLAP TEAR

SLAP TEAR		ARTHROSCOPY		
		POSITIVE	**NEGATIVE**	**TOTAL**
MRI	**POSITIVE**	12	2	14
	NEGATIVE	7	40	47
	TOTAL	19	42	61

- SENSITIVITY – 63.15%
- SPECIFICITY – 95.24%
- PPV – 85.71%
- NPV – 85.11%

For slap tear, we found sensitivity, specificity, PPV & NPV of 63.15%, 95.24%, 85.71% and 85.11% respectively.

TABLE 7 – SENSITIVITY, SPECIFICITY, NPV & PPV OF BANKARTS LESION

BANKARTS LESION		ARTHROSCOPY		
		POSITIVE	**NEGATIVE**	**TOTAL**
MRI	**POSITIVE**	2	3	5
	NEGATIVE	0	56	56
	TOTAL	2	59	61

- SENSITIVITY – 100.0%
- SPECIFICITY – 94.91%
- PPV – 40.0%
- NPV – 100.0%

For bankarts, we found sensitivity, specificity, PPV & NPV of 100.0%, 94.91%, 40.0% and 100.0% respectively.

TABLE 8 – SENSITIVITY, SPECIFICITY, NPV & PPV OF HILL SACHS LESION

HILL SACHS LESION		ARTHROSCOPY		
		POSITIVE	**NEGATIVE**	**TOTAL**
MRI	**POSITIVE**	3	1	4
	NEGATIVE	1	56	57
	TOTAL	4	57	61

- SENSITIVITY – 75.0%
- SPECIFICITY – 98.24%
- PPV – 75.0%
- NPV – 98.24%

For HILL SACHS LESION, we found sensitivity, specificity, PPV & NPV of 75.0%, 98.24%, 75.0% and 98.24% respectively.

TABLE 9 – CORRELATION OF AGE WITH ROTATOR CUFF PATHOLOGY ACROSS MRI & ARTHROSCOPY

ROTATOR CUFF TEAR	MRI	ARTHROSCOPY
20 – 40	8 (15.10%)	10 (18.18%)
41 – 60	29 (54.72%)	30(54.54%)
61 - 80	16 (30.18%)	15 (27.28%)
TOTAL	53 (100%)	55 (100%)

The maximum numbers of subjects in MRI for rotator cuff problems were found to be in the age group of 41-60 years (29 subject) followed by 61-80 years (16 subject) and 20-40 years (8 subject) respectively.

The maximum numbers of subjects in Arthroscopy for rotator cuff were found to be in the age group of 41-60 years (30 subject) followed by 61-80 years (15 subject) and 20-40 years (15 subject) respectively.

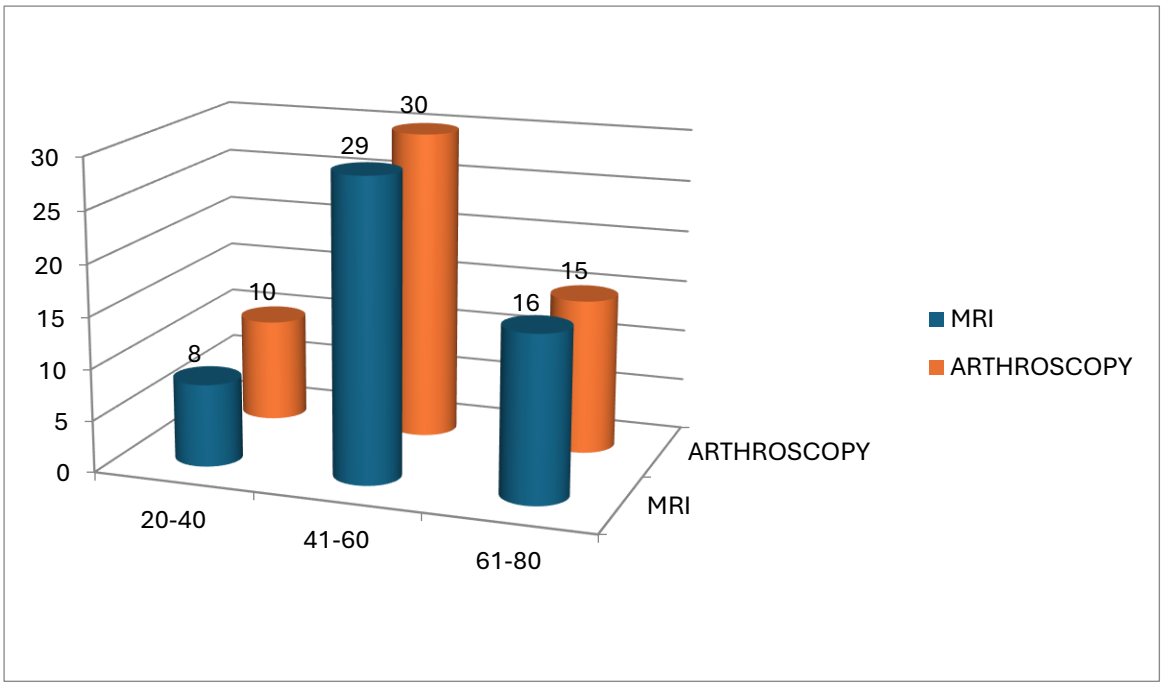


TABLE 10 – CORRELATION OF AGE WITH SLAP TEAR ACROSS MRI & ARTHROSCOPY

SLAP TEAR	MRI	ARTHROSCOPY
>20	1 (7.14%)	1 (5.26%)
21 – 40	1 (7.14%)	3 (15.79%)
41 – 60	7 (50%)	8 (42.11%)
61 - 80	5 (35.72%)	7 (36.84%)
TOTAL	14 (100%)	19 (100%)

The maximum numbers of subjects in MRI for slap tear were found to be in the age group of 41-60 years (7 subject) followed by 61-80 years (5 subject) and 21-40 years as well as >20 years showing 1 subject each.

The maximum numbers of subjects in Arthroscopy for slap tear were found to be in the age group of 41-60 years (8 subject) followed by 61-80 years (7 subject), 21-40 years (3 subject) and >20 years showing 1 subject.

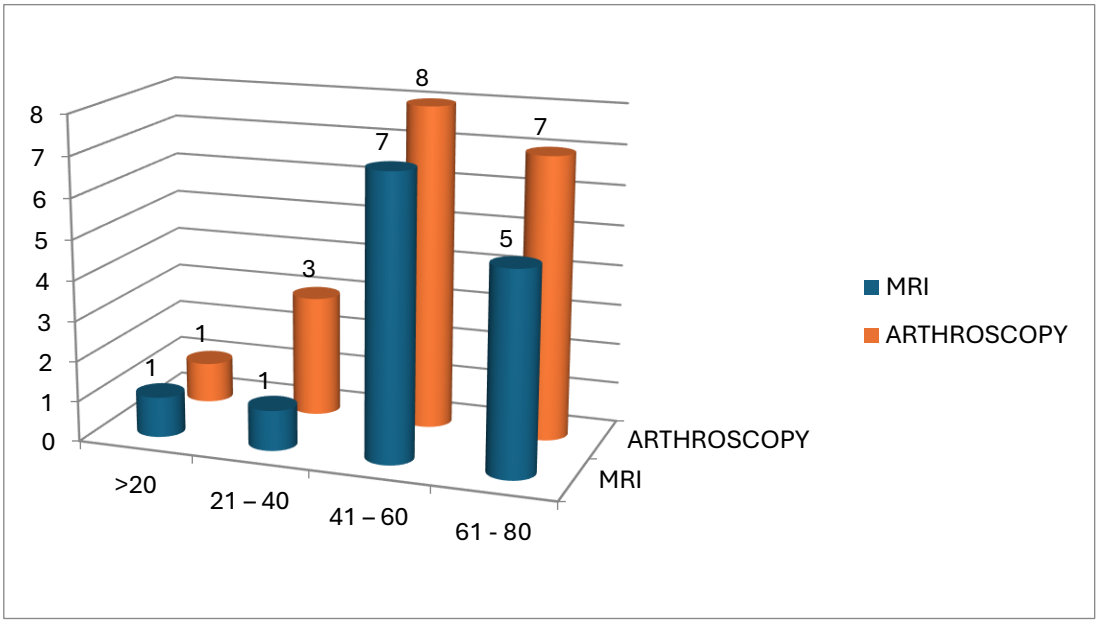


TABLE 11 – CORRELATION OF AGE WITH BANKARTS LESION ACROSS MRI & ARTHROSCOPY

BANKARTS LESION	MRI	ARTHROSCOPY
>20	0 (0.0%)	0 (0.0%)
21 – 40	0 (0.0%)	0 (0.0%)
41 – 60	4 (80%)	2 (100%)
61 - 80	1 (20%)	0 (0.0%)
TOTAL	5 (100%)	2 (100%)

The maximum numbers of subjects in MRI for bankarts lesion were found to be in the age group of 41-60 years (4 subject) followed by 61-80 years (1 subject).

The maximum numbers of subjects in Arthroscopy for bankarts lesion were found to be in the age group of 41-60 years (2 subject) respectively.

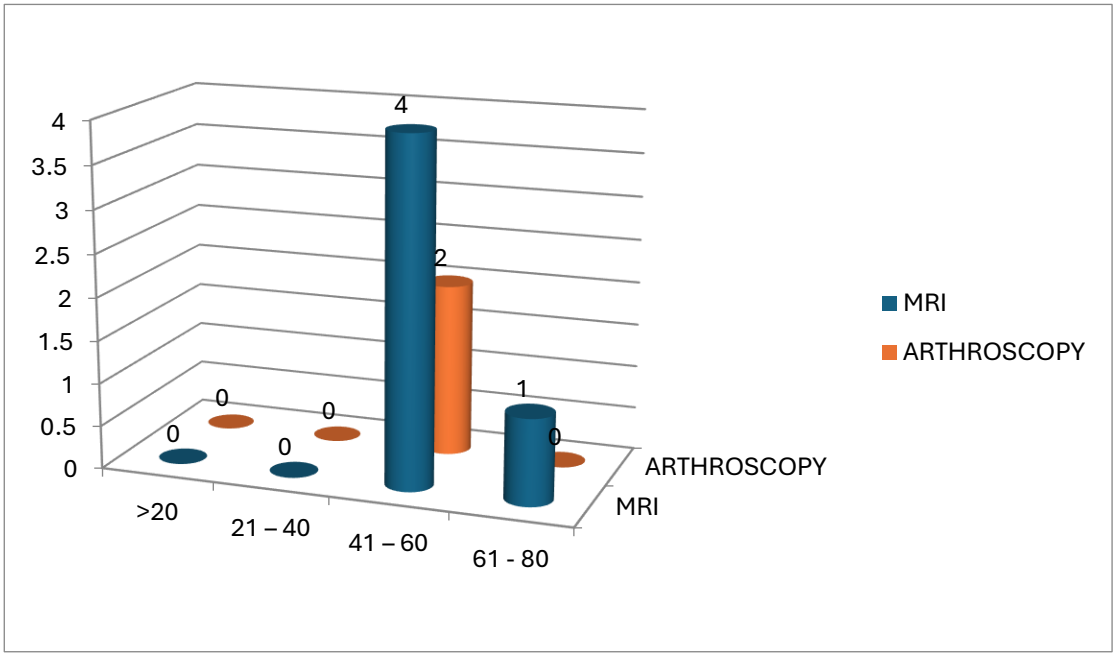


TABLE 12 – CORRELATION OF AGE WITH HILL SACHS LESION ACROSS MRI & ARTHROSCOPY

HILL SACHS LESION	MRI	ARTHROSCOPY
>20	1 (25%)	1 (25%)
21 – 40	2 (50%)	2 (50%)
41 – 60	1 (25%)	0 (0.0%)
61 - 80	0 (0.0%)	1 (25%)
TOTAL	4 (100%)	4 (100%)

The maximum numbers of subjects in MRI for Hill sachs lesion were found to be in the age group of 21-40 years (2 subject) followed by 41-60 years as well as >20 years respectively with 1 subject each.

The maximum numbers of subjects in Arthroscopy for Hill sachs lesion were found to be in the age group of 21-40 years (2 subject) followed by 61-80 years as well as >20 years respectively with 1 subject each.

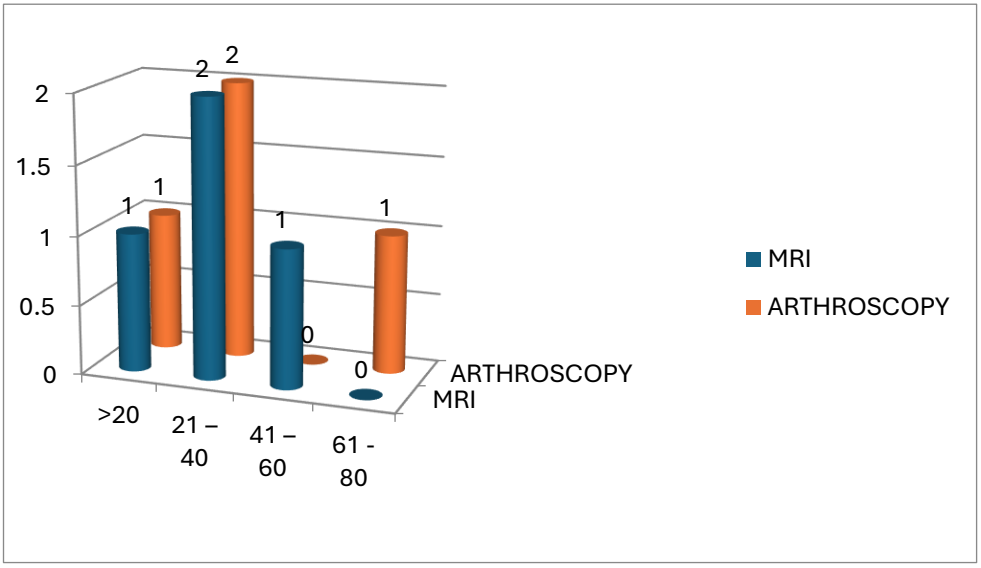


TABLE 13 – CORRELATION OF GENDER WITH ROTATOR CUFF TEAR ACROSS MRI & ARTHROSCOPY

ROTATOR CUFF TEAR	MRI	ARTHROSCOPY
MALE	28	31
FEMALE	25	24
	P = 0.712331	

P value is 0.712331.

For Rotator cuff tear, amongst males we found 28 & 31 subjects by MRI & Arthroscopy respectively.

For Rotator cuff tear, amongst females we found 25 & 24 subjects by MRI & Arthroscopy respectively.

It was found to statistically insignificant

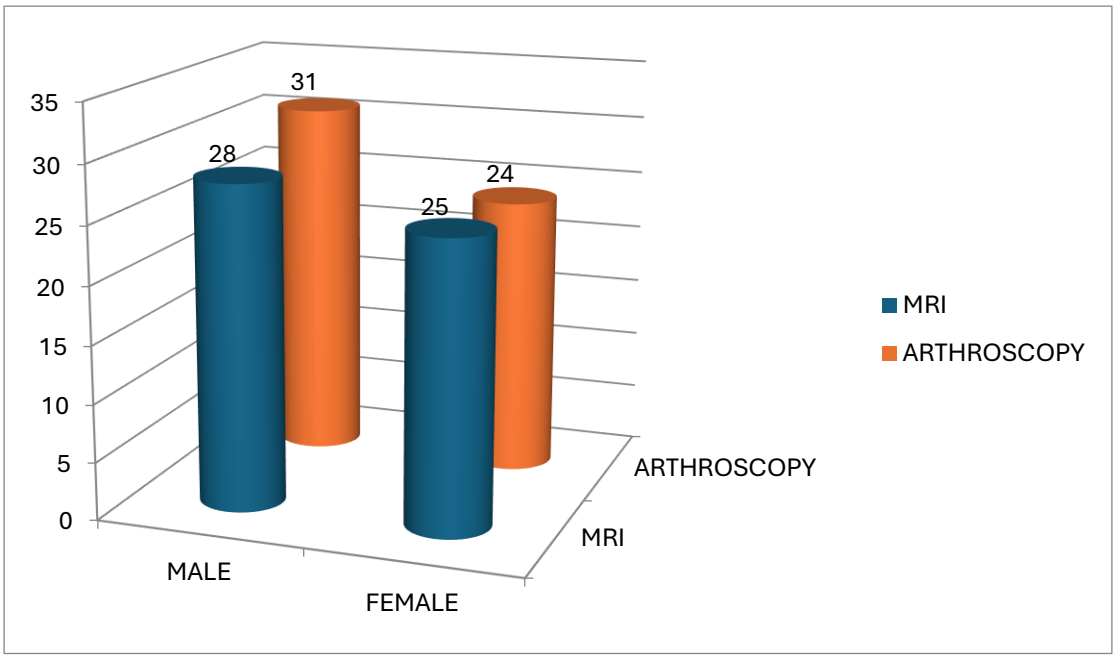


TABLE 14 – CORRELATION OF GENDER WITH SLAP TEAR ACROSS MRI & ARTHROSCOPY

SLAP TEAR	MRI	ARTHROSCOPY
MALE	8	8
FEMALE	6	11
	P = 0.3929	

P value is 0.3929.

For SLAP tear, amongst males we found 8 subjects each by MRI & Arthroscopy respectively.

For SLAP tear, amongst females we found 6 & 11 subjects by MRI & Arthroscopy respectively.

It was found to statistically insignificant

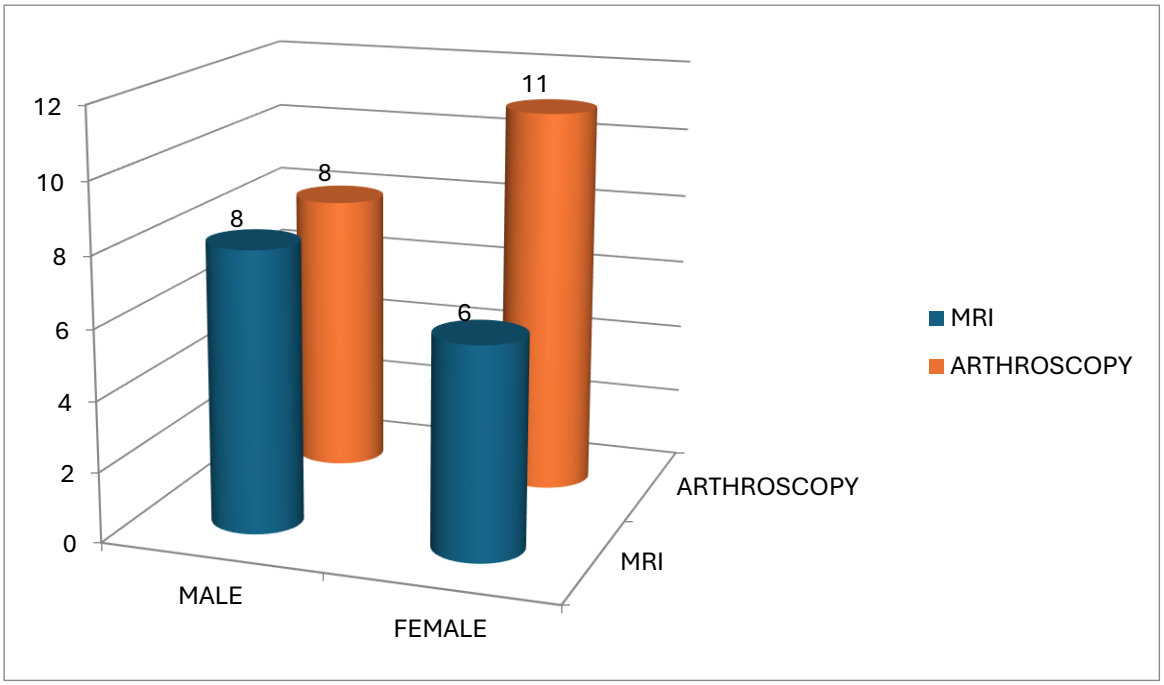


TABLE 15 – CORRELATION OF GENDER WITH BANKARTS LESION ACROSS MRI & ARTHROSCOPY

BANKARTS LESION	MRI	ARTHROSCOPY
MALE	2	1
FEMALE	3	1
	P = 0.80915	

P value is 0.80915.

For BANKARTS lesion, amongst males we found 2 & 1 subjects by MRI & Arthroscopy respectively.

For BANKARTS lesion, amongst females we found 3 & 1 subjects by MRI & Arthroscopy respectively.

It was found to statistically insignificant

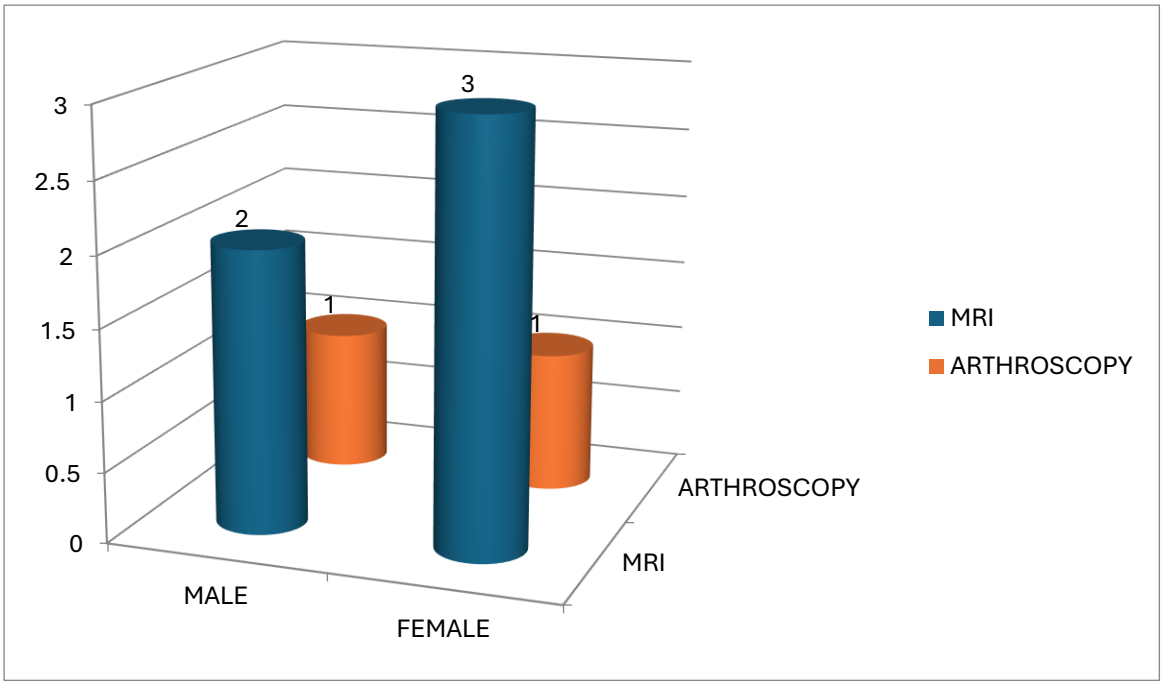


TABLE 16 – CORRELATION OF GENDER WITH HILL SACHS LESION ACROSS MRI & ARTHROSCOPY

HILL SACHS LESION	MRI	ARTHROSCOPY
MALE	4	3
FEMALE	0	1

For Hill Sachs lesion, amongst males we found 4 & 3 subjects by MRI & Arthroscopy respectively.

For Hill Sachs lesion, amongst females we found 0 & 1 subjects by MRI & Arthroscopy respectively.

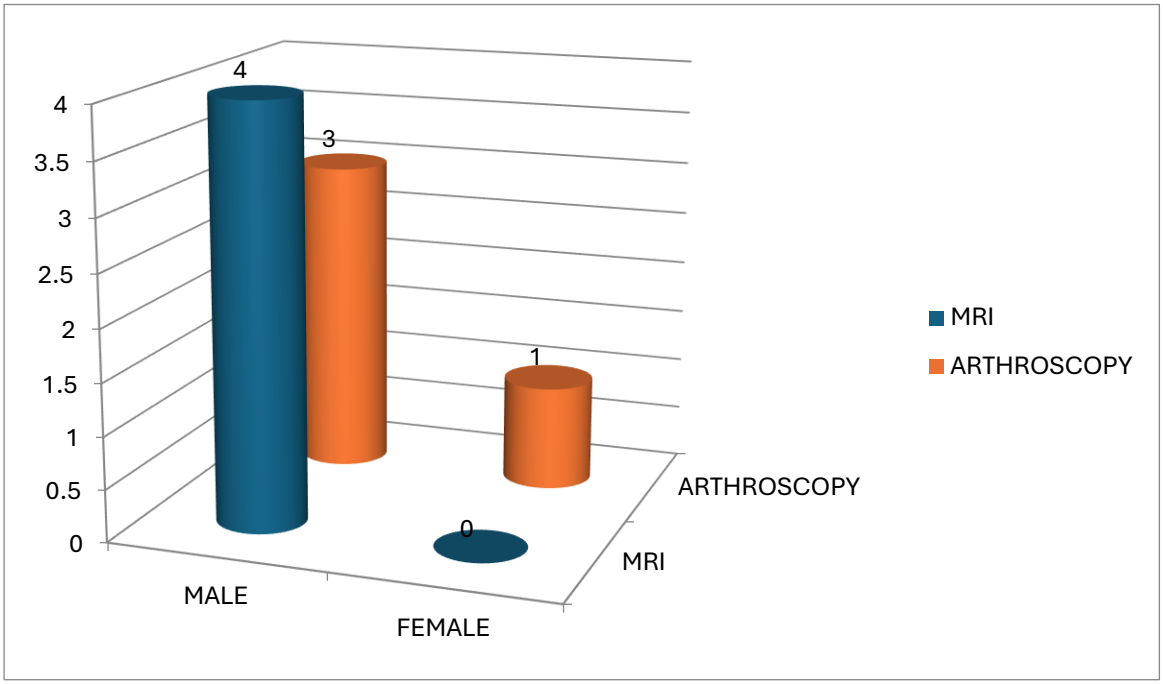


TABLE 17 – CORRELATION OF DIABETES MELLITUS FOR ROTATOR CUFF TEAR ACROSS MRI & ARTHROSCOPY

DIABETES MELLITUS – ROTATOR CUFF TEAR	MRI	ARTHROSCOPY
YES	35	34
NO	18	21
	P = 0.648106	

P value is 0.648106

Study recorded 35 and 34 diabetic subjects by MRI & Arthroscopy for rotator cuff tear, which was found to be statistically insignificant.

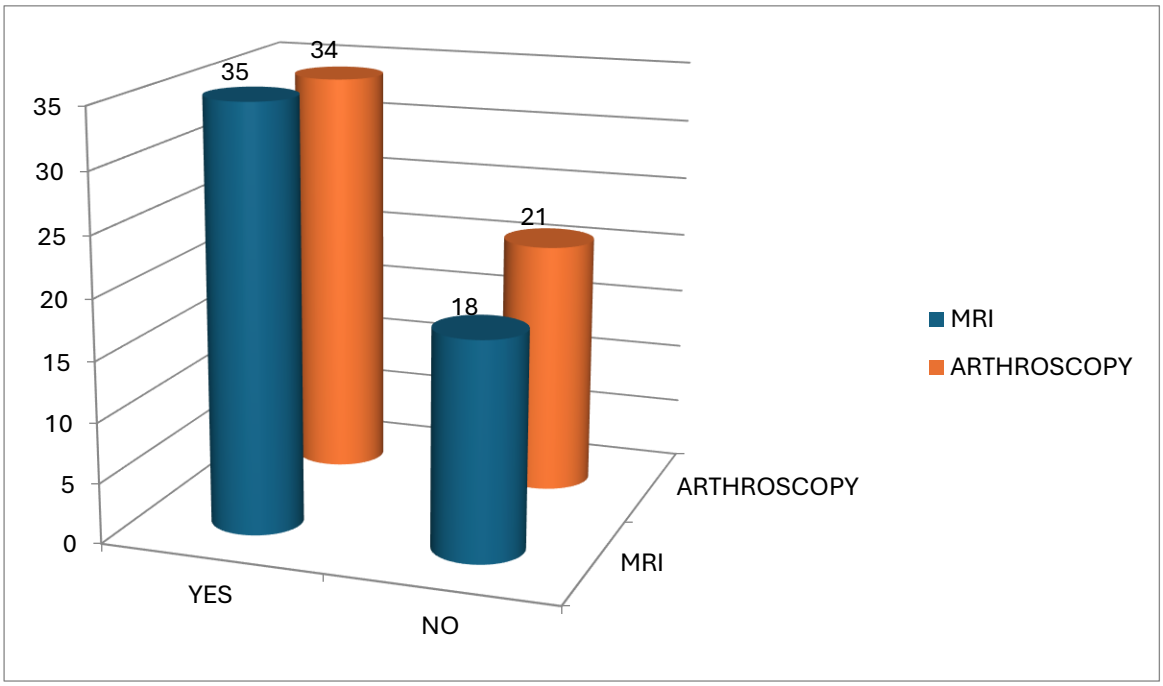


TABLE 18 – CORRELATION OF DIABETES MELLITUS FOR SLAP TEAR ACROSS MRI & ARTHROSCOPY

DIABETES MELLITUS – SLAP TEAR	MRI	ARTHROSCOPY
YES	8	10
NO	6	9
	P = 0.7797004	

P value is 0.797004.

Study showed 8 and 10 diabetic subjects by MRI & Arthroscopy for SLAP TEAR, which was found to be statistically insignificant.

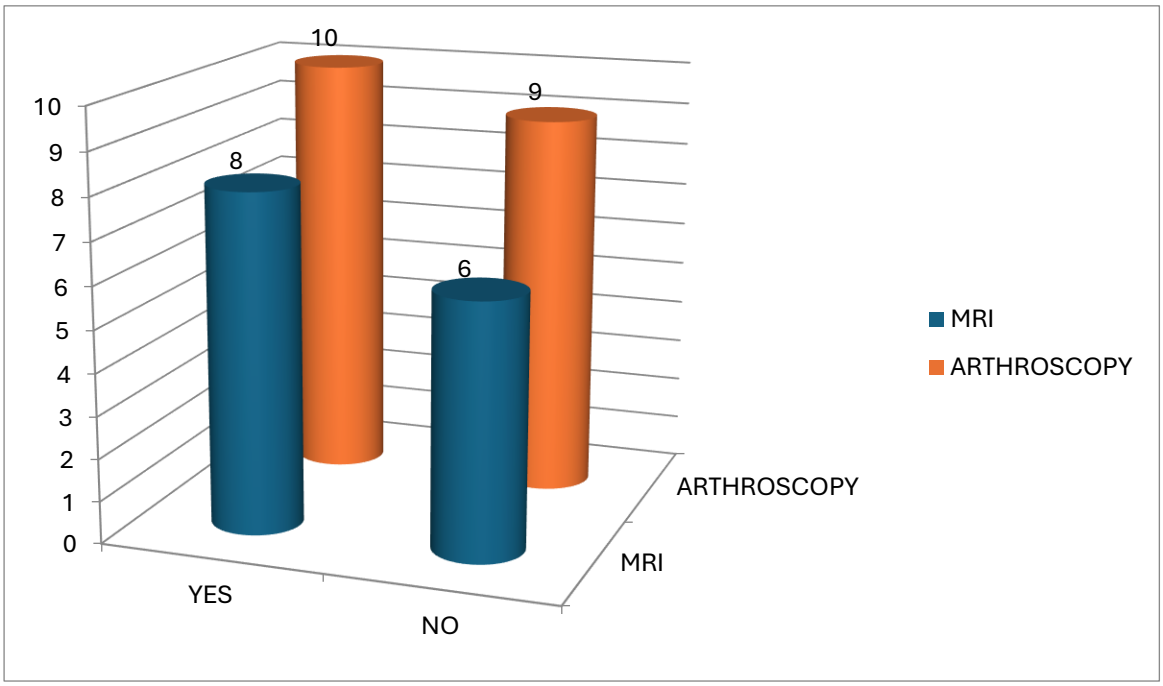


TABLE 19 – CORRELATION OF DIABETES MELLITUS FOR BANKARTS ACROSS MRI & ARTHROSCOPY

DIABETES MELLITUS – BANKARTS LESION	MRI	ARTHROSCOPY
YES	4	2
NO	1	0
	P = 0.898195	

P value is 0.898195.

Out of 37 diabetics, Study showed 4 and 2 diabetic subjects by MRI & Arthroscopy for BANKARTS Lesion, which was found to be statistically insignificant.

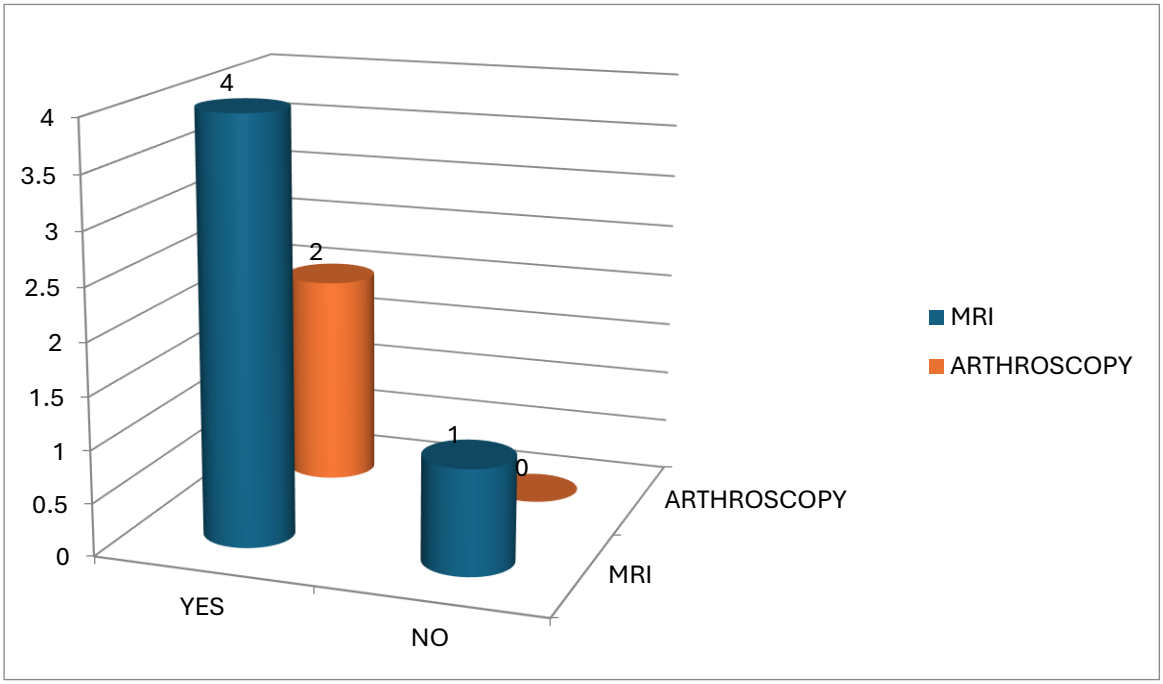
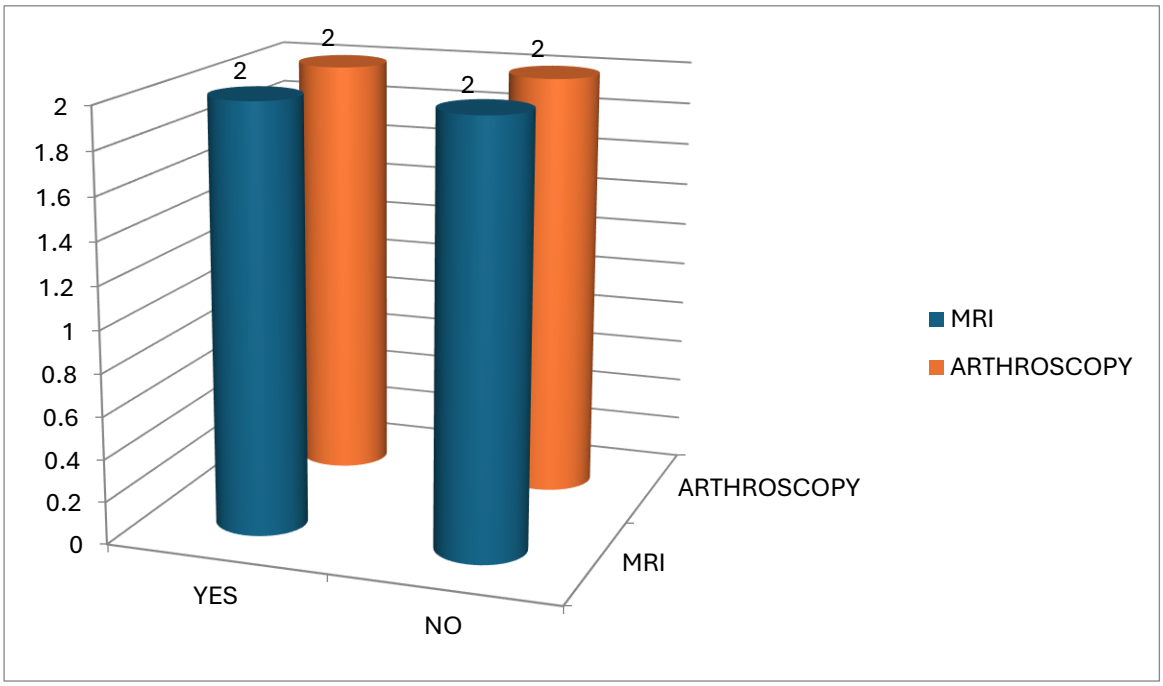


TABLE 20 – CORRELATION OF DIABETES MELLITUS FOR HILL SACHS ACROSS MRI & ARTHROSCOPY

DIABETES MELLITUS – HILL SACHS LESION	MRI	ARTHROSCOPY
YES	2	2
NO	2	2
	P = 1	

P value is 1.

Study showed 2 diabetic subjects each by MRI & Arthroscopy for Hill Sachs lesion, which was found to be statistically insignificant.



DISCUSSION

Orthopedicians reckon shoulder pain as the third most common complaint trailing spine and knee pain(21,25), such patients commonly have injury/pathologies related to rotator cuff. It is of utmost importance to identify the pathology and its extent for the surgeon to decide the final course of action(36,37).

Even though clinical evaluation provides necessary information regarding diagnosis and treatment planning, it is important to use other diagnostic modalities including imaging to reach a definitive diagnosis. MR arthrograms, magnetic resonance imaging (MRI), and high resolution dynamic ultrasound are the diagnostic procedures used in conjunction with conventional arthroscopy, which is considered the gold standard. These not only provide data regarding the shoulder anatomy and biomechanics, but also helps us to assess any other rotator cuff pathology(25).

Shoulder arthroscopy allows the operating surgeon to clearly visualize the joint and the pathology with the help of 20X magnification, thus proving itself as a “gold standard” (38). Nonetheless, it has shortcomings such as being invasive, capsule flaccidity due to altered joint laxity, chances of infection whilst causing damage to adjacent Neurovascular structures as well as fluid extravasation causing other systemic complications. Other complications can be attributable to the use of anaesthesia.

These shortcomings can be overcome by MRI, which is found to be sensitive, accurate and acts as a non-invasive tool for investigation of any shoulder pathology while providing a view of the interstitial pathlogy of the rotator cuff(39).

The Magnetic resonance imaging also assesses the status of the injury along with their severity levels acting independently or in conglomeration together with other structures. MRI also provides superior soft tissue resolution, making it a preferred diagnostic tool for rotator cuff injuries(25).

Limitations of MRI are being it is an expensive diagnostic tool, It is not available in all medical centres as it involves a lot of capital, Not as quick as CT/USG, with absolute contraindications of having metallic implants in the body(25).

Alternatively, MR arthrography has been found to be superior in delineating intra-articular pathologies but has the disadvantage of being invasive like arthroscopy which makes plain MRI a preferred choice(25).

We found majority of patients are from the ages between 41-60, trailed by 61-80 years age group and subjects of 21-40 years age group. Further, we recorded the mean age of the subjects in the age group of <20, 21-40, 41-60 & 61-80 to be 20 ± 0, 33.08 ± 6.87, 51.06 ± 5.46 and 65.87 ± 3.34 respectively, which was statistically significant.

This is in agreement with Bhatnagar et al(36)where “they found 82% of the patients to be aged above 40 years of age with 56.41% of them in the age group of 40-60 years”.

Muthami KM et al.,(40) found “majority of patients to be aged between 45 and 49 (24%) years and between 60 to 64 years (21%)”.

Also, De jong BA et al(41) and Meidema H et al(42)in their studies found that ages more than 45 were susceptible to shoulder pathologies. Goarke P et al(43) in their study recorded the median age to be 47 years.

The majority of the subjects in our study were males, accounting(43) to 54.10% (33), with 45.90% (28) being female subjects.

Literature review shows a definite male predilection for shoulder injuries, irrespective of the location or any race or cultural practices.

The study carried out by Bhatnagar A et al.,(36)showed very similar results as to ours wherein they found 22 Males (56%) and 17 females (44%). Muthami KM et al(40) reported 62% (21) male patients and 13 (38%) female patients. Groarke P et al(43) reported 74.5% male subjects in their study.

The increased incidence and prevalence of male subjects incurring shoulder injury can be attributed to several reasons such as occupation, increased physical workload, road traffic accidents, increased outdoor activities as well as other risk factors.

Our evaluation for other systemic diseases which may cause the subject to be more susceptible/ impact the output of shoulder injury. We recorded 41 (67.21%) hypertensive and 37 (60.66%) diabetes mellitus subjects.

Majority of the subjects had hypertension and were also found to be diabetics. Diabetes is known to be a high-risk factor for most of the diseases or conditions as it not only worsens the shoulder injury but also delays wound healing with higher susceptibility to infections and complications, all of which increase the healing time.

It is important to confirm and assess the level of injury once a clinical diagnosis of shoulder injury is rendered. Majority of the subjects present with rotator cuff tear which should be evaluated by assessed and defined in terms of extent by means of imaging such as arthroscopy, ultrasonography, and MRI(26).

Even though arthroscopy is the gold standard test, it is not the first choice as it is invasive, and the other alternatives are ultrasound and MRI(26).

Additionally, MRI has the capability to define extent of the tear, the amount of retraction and the overall health of the joint. The structures around the shoulder can also be viewed with MRI such as LHB, Acromio-clavicular joint & acromial properties(44).

Various researchers have put forward evidence that MRI is not only in par with arthroscopy and USG but has also surpassed their efficiency in detection of the underlying conditions(26,45).

ROTATOR CUFF PATHOLOGY

Four muscles and tendons work together to support the shoulder joint from the front to the back. This group is known as the rotator cuff. The four muscles that make up the rotator cuff are the teres minor, infraspinatus, supraspinatus, and subscapularis. They facilitate glenohumeral joint motion and are essential to the concavity-compression stability concept. (46,47).

In order to abduct the arm at the shoulder, supraspinatus depresses the scapula and works in tandem with the deltoid muscle. Infraspinatus medially rotates the humerus, providing restriction against the anterior dislocation of the humerus during abduction, and assists in the external rotation of the shoulder in conjunction with the teres minor. Any harm will cause significant dysfunction and instability in the shoulder.

The foremost causes of pain in shoulder is linked to tears in the rotator cuff with others being inflammation, impingement and instability(25,48).

We found 53 and 55 subjects by MRI & Arthroscopy for rotator cuff pathology, which was found to be statistically significant. With MRI we were able to diagnose more number of rotator cuff injury cases than that by arthroscopy, which can be attributed to

the 3D reconstruction properties of MRI as well as the ability of MRI to overcome the shortcomings of arthroscopy. MRI also helps in enhanced visualization of all the structures within the area of interest which may go unnoticed in arthroscopy.

Further for rotator cuff pathologies, we found the sensitivity, specificity, PPV & NPV to be 96.08%, 60.0%, 92.45% and 75% respectively. Similar study carried out by Bhatnagar A et al., recorded a sensitivity, specificity, PPV & NPV of 0.91, 1, 1 & 0.63 respectively for rotator cuff

Further for rotator cuff pathologies, we found the sensitivity, specificity, PPV & NPV to be 93.33%, 21.74%, 28.0% and 90.91% respectively. Similar study carried out by Bhatnagar A et al.,(36) recorded a sensitivity, specificity, PPV & NPV of 0.91, 1, 1 & 0.63 respectively for rotator cuff tears.

Iannotti *et al.,*(49) showed that "MRI was 100% sensitive and 95% specific in the diagnosis of complete rotator cuff tears, and in differentiating tendinitis from degenerative changes, it was 82% sensitive and 85% specific." Loeffler *et al,*(50) demonstrated "the efficacy of MRI with sensitivities and specificities ranging from 85% to 100% for both partial- and full-thickness tears."

Frei et al., (51) showed a "sensitivity of 0.92 and specificity of 1.0 and claimed that MRI is one of the most effective ways for rotator cuff tear diagnosis". A study by Motamedi *et al,*(52) found "sensitivity for MRI of 91% after rotator cuff repair by correlating radiologists MRI interpretation with surgical findings."

A systematic review carried out by Lenza et al.,(53) reviewed "correlation of rotator cuff tears in MRI and arthroscopy, advocated that MRI has good diagnostic accuracy for full-thickness tears." Nonetheless, they found poor sensitivity in cases of partial-thickness tears.

The reasons for undiagnosed lesions can be attributed to mechanical limitations of detecting undersurface tears especially delaminating tears and unique oblique orientation of the supraspinatus tendon to the imaging plane(27,36).

Radiologist Workload: The volume of work handled by radiologists can affect the time allocated to thoroughly examine each MRI study, potentially leading to insufficient evaluation of critical details necessary for an accurate diagnosis. This issue is particularly pertinent in general radiology settings where radiologists deal with a broad spectrum of imaging studies or in high volume trauma centres.

MRI related factors: The magnetic field strength of the MRI machine has been playing a pivotal role in shaping the quality of the images produced. MRI machines with lower Tesla strength (e.g., 1.5T) may not capture as much detail as those with higher Tesla strength (e.g., 3.0T), especially when assessing subtle or complex shoulder joint conditions. Dedicated musculoskeletal imaging centers typically utilize higher Tesla MRI machines to achieve superior image resolution for such cases(40).

Sometimes, there are MRI over-diagnosis of rotator cuff tendinitis which is most commonly caused due to magic angle phenomenon or presence of intestitial tears which cannot be detected by arthroscopy(40).
Research data shows more than 62% of patients presenting with shoulder pain are >80 years of age. On the other hand, younger age group form only <9.2%(46).

We found the maximum numbers of subjects (in MRI vs Arthroscopy) for rotator cuff tears were found to be in the age group of 41-60 years (29 vs 30 subjects) followed by 61-80 years (16 vs 15 subjects) and 21-40 years (8 vs 10 subjects) respectively. MRI was found to be 60-70% more efficacious in detection of rotator cuff tear than in arthroscopy.

Amongst diabetics, our study detected 35 and 34 diabetic subjects by MRI & Arthroscopy for Rotator cuff injuries, which was found to be statistically significant. It is important to consider systemic conditions such as diabetes as they may play a direct/indirect role in the diagnosis, operative as well as post-operetive stages of the injury. Only 96.08% of rotator cuff injuries was detected by MRI in comparison to that by arthroscopy, with the underlying reason for it being unknown(40).

SLAP TEAR

Our study showed 14 and 19 subjects by MRI & Arthroscopy for slap tear, which was found to be statistically insignificant. Herein, arthroscopy was more efficacious in detection of subjects with SLAP tear in comparison to that by MRI.

Further statistical analysis for slap tear showed sensitivity, specificity, PPV & NPV of 63.15%, 95.24%, 85.71% and 85.11% respectively.
Bhatnagar A et al.,(36) in their study found "sensitivity, specificity, PPV & NPV of 0.15, 0.96, 0.67 & 0.69 respectively for slap lesion". OR Momenzadeh et al.,(33) found "sensitivity, specificity, PPV & NPV of 0.74, 0.80, 0.78 & 0.76."

We also found, the maximum numbers of subjects in (MRI vs arthroscopy) for slap tear were found to be in the age group of 41-60 years (7 vs 8 subjects) followed by 61-80 years (5 vs 7 subjects) and 21-40 years (1 vs 3 subjects) which was completely opposite to that observed in case of rotator cuff injuries.

For slap tear, we found 8 males by MRI & Arthroscopy, whereas it was 6 & 11 subjects in case of females. Herein, arthroscopy was found to be more efficacious in diagnosing slap tear lesions in females in comparison to MRI. There is no definite reason for it, however we hypothesize it to be due to some anatomical differences across the genders.

Amongst diabetics, we found 8 and 10 subjects by MRI & Arthroscopy for SLAP TEAR. We know that arthroscopy is an invasive procedure which can cause structural damage and diabetes is a chronic condition which increases tissue damage, so can that be causal-effect relationship is a hypothetical question.

BANKARTS LESION

We found 5 and 2 subjects by MRI & Arthroscopy for BANKARTS Lesion, with a sensitivity, specificity, PPV & NPV of 100.0%, 94.91%, 100.0% and 40.0% respectively.

Similar study by Bhatnagar A et al.,(36) found "sensitivity, specificity, PPV & NPV of 0.8, 1, 1 & 0.89 respectively for Bankarts tear".

O.R Momenzadeh et al.,(33)found "it to be 050, 0.84, 0.77 & 0.60 suggestive of deficiency in sensitivity and mild specificity in detecting Bankarts tear."

Similarly, Iannotti et al.,(54) Joshi U et al.,(55)& Lee CS et al.,(56) all had similar findings in their studies.

However, Torstensen ET et al in his study found "that MRI identified labral injuries with accuracy of 62%, sensitivity 73%, and specificity 58%."(32)

The maximum numbers of subjects (in MRI vs arthroscopy) for Bankarts were found to be in the age group of 41-60 years followed by 61-80 years (1 vs 0 subject) with MRI being able to detect a greater number of Bankarts tear which arthroscopy was not able to detect. Herein, it is difficult to conclude if it is really a lesion missed by arthroscopy or MRI over-diagnosis as the difference is small, with the bias levels being higher.

For Bankarts lesion, we found (2 males & 3 female subjects by MRI), whereas it was only 1 male & female subject each by arthroscopy respectively. Also, amongst diabetics, we found 4 and 2 diabetic subjects by MRI & Arthroscopy.

HILL SACHS LESION

We found 4 positive subjects each in MRI as well as Arthroscopy for Hillsachs lesion, with sensitivity, specificity, PPV & NPV of 75.0%, 98.24%, 75.0% and 98.24%.

No significant difference noted in the number of subjects across various age groups, however the most affected age group of patients here belonged to 21-30 years of age group rather than that observed in other type of injuries we assessed.

Herein, most commonly male subjects were affected in comparison to female subjects, which was more clearly detected by MRI than that by arthroscopy.

Kirkley et al.& Hodler J et al. (57,58) in their studies found out that there was a fair correlation for rotator cuff injuries whereas the MRI showed it was excellent at detecting Hill-sach's and Bankart's lesions & a moderate sensitivity for superior labral lesions, When the MRI was compared against arthroscopy to multiple shoulder disorders.

Our study showed definitive capabilities of MRI as a diagnostic modality in contrast to the gold standard arthroscopy. MRI with its non-invasive definitive sharp 3D image reconstructive quality is looking as a promising tool for the future diagnostics, therefore, we highly recommend the use of MRI for shoulder injuries as an adjuvant tool to arthroscopy in the current scenario while there is sufficient added to make it as a standalone diagnostic tool.

CONCLUSION

The latest technological advancements have helped boost the diagnostic accuracy of MRI, We found that MRI was capable in diagnosing the most common shoulder injuries when compared to arthroscopy, which remains the undisputed gold standard diagnostic modality.

The most common injuries in our study were rotator cuff injuries which were efficaciously detected by MRI (on par with arthroscopy) with good sensitivity and specificity.

For SLAP tears Arthroscopy is still the superior diagnostic tool.

Evidence is suggestive that the MRI is on par with arthroscopy for detection of Hill Sachs lesion and Bankarts lesion.

The advantages of MRI, such as being non-invasive, 3D viewing, storage and transfer of image along with its capability to overcome the shortcomings of arthroscopy have favored its use. However, the lack of access, expensiveness, and the availability of the physician to interpret the image have been some of the major setbacks in using it as the primary diagnostic modality.

There is a dearth shortage in terms of data in terms of usage of MRI as a primary diagnostic modality. Therefore, we recommend using MRI as an adjuvant diagnostic modality to arthroscopy to attain a definitive diagnosis reducing/eliminating any chances of missing any shoulder injury.

LIMITATIONS & FUTURE RECOMMENDATIONS

There are a few limitations in our study such as that the patients suitable for surgery were part of the study. Arthroscopy being considered as reference standard is a potential source of bias, Also the operating surgeons were aware of the patients MRI findings preoperatively. This may affect the verification bias, but it would be unethical to blind the operating team pre operatively as it would affect the planning for the surgery. There are few patients with delay in assessment by arthroscopy after the MRI for various reasons – Financial, Personal, Issues with fitness etc this potentially might lead to progression or resolution of the disease. Efforts were made to enrol all the patients for arthroscopic surgery after MRI scan was done.

- In our study, we had a limited sample size which might not reflect the true burden of the disease
- There is a dearth need for large multi-centric studies
- We recommend multi-physician interpretation of image to eliminate any MRI over-diagnosis
- Assessment of other confounding factors, affecting the diagnosis, treatment & prognosis
- A uniform coding system can be applied for diagnosis which may help set the type of treatment – conservative or surgical type

SUMMARY

- Mean age of subjects in the age group of <20, 21-40, 41-60 & 61-80 was found to be 20 ± 0, 33.08 ± 6.87, 51.06 ± 5.46 and 65.87 ± 3.34 respectively, which was found to be statistically significant
- The study consisted of 33 (54.10%) male and 28 (45.90%) female subjects respectively.
- The study consisted of 41 (67.21%) hypertensive & 37 (60.66%) diabetes mellitus subjects respectively.
- Study showed 53 and 55 subjects by MRI & Arthroscopy for rotator cuff tears, which was found to be statistically significant, with sensitivity, specificity, PPV & NPV of 96.08%, 60.0%, 92.45% and 75% respectively.
- Study showed 14 and 19 subjects by MRI & Arthroscopy for slap tear, which was found to be statistically insignificant, with sensitivity, specificity, PPV & NPV of 63.15%, 95.24%, 85.71% and 85.11% respectively.
- Study showed 5 and 2 subjects by MRI & Arthroscopy for BANKARTS lesion, which was found to be statistically insignificant, with sensitivity, specificity, PPV & NPV of 100.0%, 94.91%, 100.0% and 40.0% respectively.
- Study showed 4 and 4 subjects by MRI & Arthroscopy for HILL SACHS lesion, which was found to be statistically insignificant, with sensitivity, specificity, PPV & NPV of 75.0%, 98.24%, 75.0% and 98.24% respectively.
- The maximum number of subjects showing rotator cuff injuries, slap tear, bankarts lesion was found to be in age group of 41-60 years, whereas Hill Sachs lesion recorded 21-40 years age group followed by others.

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ANNEXURE I

PERFORMA

COMPARISION OF MAGNETIC RESONANCE IMAGING AND ARTHROSCOPIC FINDINGS IN EVALUATION OF SHOULDER PATHOLOGY – A ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY

PATIENT NUMBER: DATE:

AGE:

SEX:

OCCUPATION:

CHIEF COMPLAINTS:

PAST HISTORY:

CO -MORBIDITIES:

CLINICAL EXAMINATION:

HEIGHT

WEIGHT

AFFECTED SHOULDER-

	ACTIVE	PASSIVE	RESTRICTED
ROM			
FLEXION			
EXTENSION			
ABDUCTION			
ADDUCTION			
INTERNAL ROTATION			
EXTERNAL ROTATION			

UNAFFECTED SHOULDER

	ACTIVE	PASSIVE	RESTRICTED
ROM			
FLEXION			
EXTENSION			
ABDUCTION			
ADDUCTION			
INTERNAL ROTATION			
EXTERNAL ROTATION			

SPECIAL TESTS

	RIGHT SHOULDER	LEFT SHOULDER
NEER TEST		
DROP ARM		
HAWKIN'S KENNEDY		
FULL CAN		
PAINFUL ARC		
EMPTY CAN		

MRI FINDINGS VS ARTHROSCOPY FINDINGS

FINDINGS	MRI	ARTHROSCOPY
SUPRASPINATUS (A) PARTIAL TEAR (B) COMPLETE TEAR		
INFRASPINATUS (A) PARTIAL TEAR (B) COMPLETE TEAR		
SUBSCAPULARIS (A) PARTIAL TEAR (B) COMPLETE TEAR		
SLAP TEAR		
BANKART LESION		
OSTEOCHONDRAL DEFECTS		

ANNEXURE II

Consent form format

KAHERs JNMC
BELAGAVI
INFORMED CONSENT FORM

"COMPARISION OF MAGNETIC RESONANCE IMAGING AND ARTHROSCOPIC FINDINGS IN EVALUATION OF SHOULDER PATHOLOGY – A ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY"

Objective: Objective of the study is to compare the efficacy of MRI in diagnosis shoulder pathologies in comparison to arthroscopy, considering arthroscopy as the gold standard

Introduction:

I have been informed by Department of orthopedics, J. N. Medical College, KLE UNIVERSITY, Belagavi is conducting a study to find out COMPARISION OF MAGNETIC RESONANCE IMAGING AND ARTHROSCOPIC FINDINGS IN EVALUATION OF SHOULDER PATHOLOGY- Hospital based study at KLE's DR PRABHAKAR KORE CHARITABLE HOSPITAL AND MEDICAL RESEARCH CENTER, BELAGAVI. Among the various Musculoskeletal diseases, shoulder pain is one of the most common complaints. In General, it is characterized by pain and limited range of motion of one or both shoulders. Shoulder pain not only causes decreased quality of life, but also leads to disability in daily activities, and could affect the financial stability of the patient.

Explanation of procedure:

Once you have signed the informed consent, necessary personal information and detailed medical history will be taken by the investigator. After this, based on clinical evaluation of pain and restrictions of movements at the shoulder joint, you will be advised MRI to correlate clinically and confirm diagnosis of shoulder pathology. After which based on diagnosis diagnostic and therapeutic Arthroscopy may or may not be advised for further management.

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

If you have any question or complaints regarding your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waiving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study "**COMPARISION OF MAGNETIC RESONANCE IMAGING AND ARTHROSCOPIC FINDINGS IN EVALUATION OF SHOULDER PATHOLOGY – A ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY**". My signature below indicates that I have decided to participate, and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE III

LIST OF PICTURES

ANNEXURE IV

	A	B	C	D	E	G	H	I	J	L	M	N	O	Q	R	S	T	W	X	Y	Z
1	Patient code	Sex	Gender	HTN	DM	ROTATOR CUFF TEAR		MRI	ARTHROSCOPY	SLAP tear		MRI	ARTHROSCOPY	BANKARTS		MRI	ARTHROSCOPY	HILL SACHS		MRI	ARTHROSCOPY
2	SP	59	F	1	1		1	1	1		1	0	0		1	1	1		1	0	0
3	SK	65	F	1	1		2	1	1		2	0	0		2	0	0		2	0	0
4	GO	60	F	1	1		3	1	1		3	0	0		3	0	0		3	0	0
5	RA	41	M	1	0		4	0	1		4	1	1		4	0	0		4	0	0
6	SA	40	F	0	0		5	0	0		5	0	0		5	0	0		5	0	0
7	AR	61	F	1	1		6	1	1		6	0	0		6	0	0		6	0	0
8	JA	49	M	1	0		7	0	1		7	0	0		7	1	1		7	0	0
9	GE	52	F	1	1		8	1	1		8	0	0		8	0	0		8	0	0
10	RJ	60	M	1	1		9	1	1		9	0	0		9	0	0		9	0	0
11	SD	56	F	0	1		10	0	1		10	0	0		10	0	0		10	0	0
12	KA	52	F	0	1		11	1	1		11	0	0		11	0	0		11	0	0
13	PA	45	F	1	1		12	1	0		12	1	0		12	0	0		12	0	0
14	VI	55	M	1	0		13	1	1		13	0	0		13	0	0		13	1	0
15	VJ	48	M	0	0		14	1	1		14	0	0		14	0	0		14	0	0
16	SU	67	F	1	1		15	1	1		15	0	0		15	0	0		15	0	0
17	SR	21	M	0	0		16	1	0		16	0	0		16	0	0		16	0	0
18	SH	68	F	1	1		17	1	1		17	0	1		17	0	0		17	0	0
19	RT	42	M	1	1		18	1	1		18	0	0		18	0	0		18	0	0
20	JU	54	F	1	1		19	1	1		19	1	1		19	0	0		19	0	0
21	ML	27	M	0	0		20	1	1		20	0	0		20	0	0		20	1	1
22	MA	50	F	1	1		21	1	1		21	0	0		21	0	0		21	0	0
23	MH	53	F	1	1		22	1	1		22	1	1		22	1	0		22	0	0
24	YA	71	M	1	0		23	1	1		23	1	1		23	0	0		23	0	0
25	GT	66	F	0	1		24	1	1		24	1	1		24	1	0		24	0	0
26	DE	51	M	0	0		25	1	1		25	1	1		25	0	0		25	0	0
27	MP	62	M	1	1		26	1	1		26	1	1		26	0	0		26	0	0
28	DN	55	F	1	1		27	1	1		27	0	0		27	0	0		27	0	0
29	SH	65	M	1	1		28	1	1		28	0	0		28	0	0		28	0	0
30	RS	47	M	1	1		29	1	1		29	0	0		29	1	0		29	0	0
31	MN	49	M	1	1		30	1	1		30	0	0		30	0	0		30	0	0
32	SA	52	F	1	1		31	1	1		31	0	0		31	0	0		31	0	0
33	SB	38	F	0	1		32	1	1		32	0	1		32	0	0		32	0	0
34	SJ	20	M	0	0		33	0	1		33	1	1		33	0	0		33	1	1
35	PR	63	M	1	1		34	1	1		34	0	1		34	0	0		34	0	0
36	MI	47	M	0	1		35	1	1		35	0	0		35	0	0		35	0	0
37	SE	67	F	1	1		36	1	1		36	1	1		36	0	0		36	0	1
38	KM	51	F	1	1		37	1	1		37	0	1		37	0	0		37	0	0
39	SM	62	M	1	1		38	1	1		38	0	0		38	0	0		38	0	0
40	NG	39	M	0	1		39	1	1		39	0	0		39	0	0		39	0	0
41	UM	34	M	0	0		40	1	1		40	0	0		40	0	0		40	0	0
42	MB	32	F	0	0		41	1	1		41	0	0		41	0	0		41	0	0
43	RD	69	M	1	1		42	1	1		42	1	1		42	0	0		42	0	0
44	MV	22	M	0	0		43	0	1		43	0	0		43	0	0		43	0	0
45	PM	40	M	1	0		44	1	1		44	0	0		44	0	0		44	0	0
46	AK	29	M	0	0		45	0	1		45	1	1		45	0	0		45	1	1
47	RK	61	M	1	0		46	1	0		46	0	0		46	0	0		46	0	0
48	CH	43	F	1	0		47	1	1		47	0	0		47	0	0		47	0	0
49	VI	55	F	1	0		48	1	1		48	1	1		48	0	0		48	0	0
50	SI	58	M	1	0		49	1	1		49	0	0		49	0	0		49	0	0
51	SS	49	M	1	0		50	1	1		50	0	0		50	0	0		50	0	0
52	KD	58	F	1	0		51	1	1		51	0	1		51	0	0		51	0	0
53	ST	38	F	0	0		52	1	1		52	0	1		52	0	0		52	0	0
54	SV	67	M	1	1		53	1	1		53	0	0		53	0	0		53	0	0
55	BA	42	M	0	0		54	1	1		54	0	0		54	0	0		54	0	0
56	VK	69	M	1	1		55	1	1		55	0	0		55	0	0		55	0	0
57	SK	49	M	1	0		56	1	1		56	1	0		56	0	0		56	0	0
58	SP	37	F	0	1		57	0	0		57	0	0		57	0	0		57	0	0
59	PD	43	M	0	1		58	1	1		58	0	0		58	0	0		58	0	0
60	SC	53	F	1	1		59	1	1		59	0	1		59	0	0		59	0	0
61	ME	56	F	1	1		60	1	0		60	0	0		60	0	0		60	0	0
62	BP	71	M	1	1		61	1	1		61	0	0		61	0	0		61	0	0