"ASSESSMENT AND FUNCTIONAL EVALUATION OF SHOULDER FOLLOWING MINI OPEN ROTATOR CUFF REPAIR."

By

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Dissertation submitted to

The BLDE (DEEMED TO BE) UNIVERSITY, VIJAYAPURA, KARNATAKA

In partial fulfillment of the requirements for the degree of

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Under the guidance of

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ABSTRACT

Introduction : Shoulder pain is a common complaint among patients presenting with musculoskeletal disorders, with rotator cuff tears being one of the most prevalent problems. Rotator cuff tears may present with a variety of clinical features including debilitating shoulder pain and decreased range of motion. The objective of rotator cuff repair is to alleviate pain and improve function and strength of the affected shoulder. Advances in procedure now allow rotator cuff repair of even largest tears and repair techniques are required to mobilize many of retracted tears. Mini open rotator cuff repair [MORCR] surgery allows for a shorter recovery time and predictably less pain in first few days following procedure than does any open surgery.

Objectives: To assess the functional outcome of the shoulder joint in the patients who had undergone mini open rotator cuff repair.

Methodology : We enrolled 40 patients with the diagnosis of rotator cuff tear with strict inclusion criteria.

Results : The mean of age was 48.5 ± 14.79 years. 60% subjects were male. 40% subjects were retired personal, 15% were sports person. 52.5% subjects had left side affected. The duration of symptoms was 12.75 ± 7.08 months. 37.5% subjects had degenerative type of injury. The mean of Pre OP VAS was 4.6 ± 3.12. 32.5% subjects had small tear size. The DASH score significantly decreases over time ($p < 0.001$), indicating reduced disability. This confirms progressive recovery in arm, shoulder, and hand function. UCLA score significantly improves over time ($p < 0.001$). all shoulder movement parameters showed statistically significant improvement at 6 months postoperatively.

Conclusion : Based on the findings of this study it may be concluded that, mini-open rotator cuff repair of shoulder joint results in excellent functional outcome among adult patients with rotator cuff tear of shoulder joint especially after six months with gradual improvement with respect to time as assessed by DASH score and ULCA score. It also offers complete pain relief without any complications.

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Abbreviations

Mini open rotator cuff repair – MORCR

Electromyographic – EMG

rotator cuff tendons – RCT

acromioclavicular – AC

range of movement – ROM

internal rotation – IR

External rotation - ER

graded index lens system - GRIN

Mini operator cuff repair - MOCR

INTRODUCTION

INTRODUCTION

Shoulder pain is a common complaint among patients presenting with musculoskeletal disorders, [1] with rotator cuff tears being one of the most prevalent problems.[2] Subacromial impingement is often the underlying cause of pain, encompassing a range of conditions from tendonitis and bursitis to rotator cuff tears, and potentially progressing to cuff tear arthropathy if not addressed promptly. Early diagnosis and treatment are essential to prevent further complications.

Rotator cuff tears can cause significant shoulder pain, limited mobility, and weakness. The aim of rotator cuff repair is relieve distress, restore function, and enhance strength in the affected upperlimb. Ideal repair of the rotator cuff enlists high fixation strength with none to minimal residual gap while conserving mechanical stability under cyclic loading, and allowing adequate healing of tendon on bone at the same time. [3]

First line of treatment for most tears is non-operative management, however, surgical repair is indicated when conservative management fails or in large tears. [4] Rotator cuff repair is a cost-effective treatment, with surgical technique choice depending on the surgeon's preference. The mini-open technique has been the gold standard, boasting a 90% success rate due to its advantages, including stronger suture fixation, reduced deltoid morbidity, and a more accessible learning curve compared to arthroscopic methods On the other hand, Arthroscopic technique is a newer skill with development of specialized surgical equipment [5]

Rotator cuff disease encompasses a wide range of pathology from minimal bursal or articular side irritation and tendonitis to severe degenerative rotator cuff arththropathy. Rotator cuff pathology affects adults of all ages and other shoulder afflictions must be ruled out by careful history and physical examination [6]. Epidemiological studies intensely support association between age and cuff tears prevalence. In a recent study the frequency of such tears increased from 13% in youngest group (aged 50-59yrs) to 20% (aged 60-69yrs) 31% (aged 70-79yrs) and 51% in oldest group (aged 80-89yrs) [7]. Recently small tears were treated arthroscopically while larger tears required an open procedure.

Current research demonstrates that there exists significant variability in the prescribed periods of immobilization and time elapsed before initiation of active shoulder movement, with those surgeons who have pursued early rehabilitation permitting passive movement during the first two to four weeks.11-13 Delays in commencing active movement may predispose patients to developing post-operative stiffness, delaying recovery and return to work. [8]

Advances in rotator cuff repair now enable successful treatment of even large tears, with techniques that mobilize retracted tears. Results are comparable to open surgery, and the procedure allows for thorough evaluation of the shoulder, increasing diagnostic value as it can identify other potential causes of shoulder pain.. Mini open rotator cuff repair [MORCR] surgery allows for a shorter recovery time and predictably less pain in first few days following procedure than does any open surgery [7]

During the past 3 decades, it has dramatically changed the orthopedic surgeon's approach to the diagnosis and treatment of a variety of joint ailments. A high grade of clinical

accuracy combined with low morbidity, has refreshed the use of mini open rotator cuff to assist in diagnosis, determine prognosis, and to provide treatment. These procedures should serve as adjuncts to and not as replacements for thorough clinical evaluation and is not a substitute for clinical skills. [7]

OBJECTIVES

OBJECTIVES

- To assess the functional outcome of the shoulder joint in the patients who had undergone mini open rotator cuff repair.

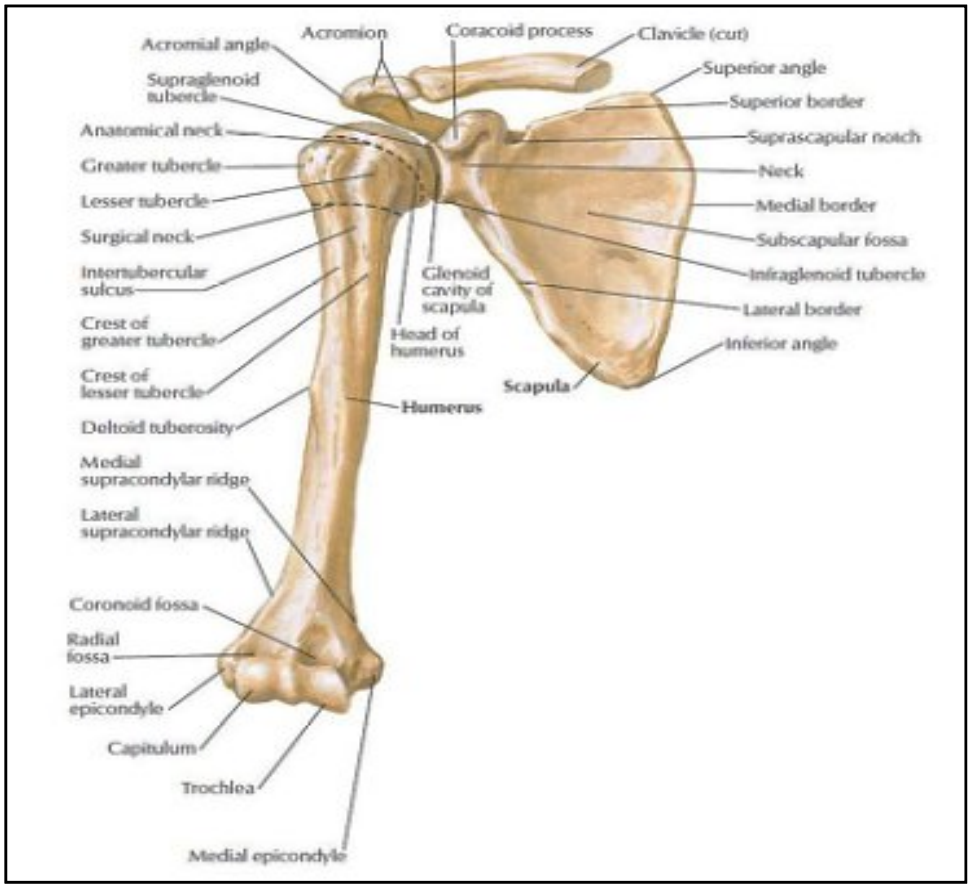
REVIEW OF LITERATURE

REVIEW OF LITERATURE

ANATOMY OF THE ROTATOR CUFF

The 4 articulation of the shoulder joint are – Sternoclavicular joint, Acromioclavicular joint, Glenohumerral joint and Scapulothoracic joint. [9]

Fig 1 :



Glenohumeral joint and Acromioclavicular joint

The term ‘rotator cuff’ is unoriginally means the tendinous parts of 4 rotator cuff muscles. That is the supraspinatus, infraspinatus, subscapularis, and teres minor muscles and tendons. [10]

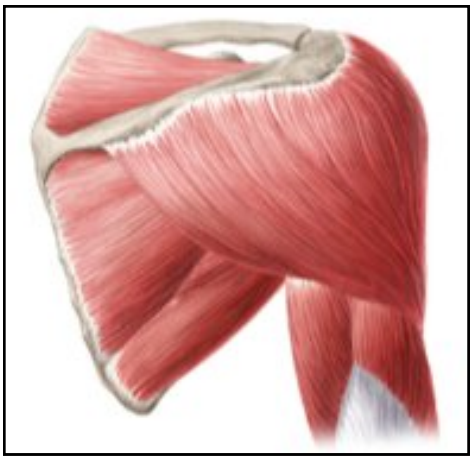


Fig 2 : Rotator Cuff – Posterior View

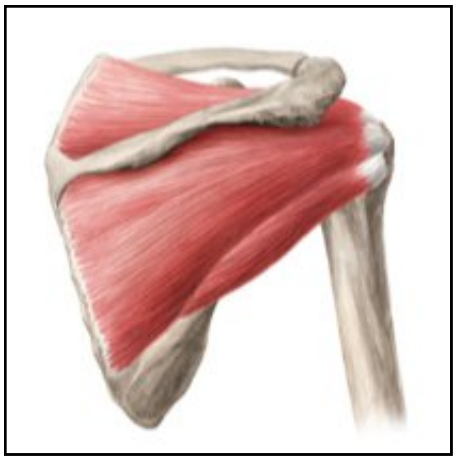


Fig 3 : Rotator Cuff – Anterior View

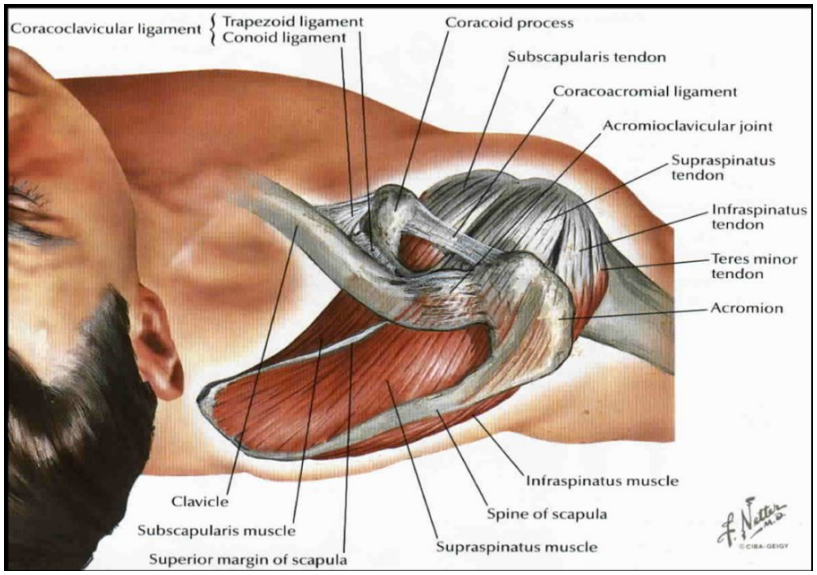


Fig 4 : Superior view of rotator cuff muscles

Subscapularis muscle

The subscapularis muscle is a triangular, bulky muscle that forms the anterior part of the rotator cuff. It originates from the subscapular fossa, with fibers attaching to the periosteum, tendinous septa, and aponeurosis. The muscle converges into a broad tendon that inserts onto the lesser tubercle of the humerus, playing a crucial role in shoulder stability and movement.. The footprint is on an average 40 mm long and 20 mm wide. [11]

Clark and Harryman (1992) found that the rotator cuff tendons have distinct layers and that the supraspinatus and subscapularis tendons interdigitate to form the floor of the bicipital groove. The subscapularis tendon inserts onto the lesser tuberosity with both tendinous and muscular components.. In a cadaveric study, the tendinous portion was found to have an average height of 2.5 cm and a width of 1.8 cm. [12,13] Larger height measurements have been reported in a similar cadaveric study [14] and via an intra-articular measurement, [15] which could represent inclusion of the muscular portion of the insertion.

The subscapularis muscle receives its blood supply from branches of the suprascapular, axillary, and subscapular arteries. It is innervated by the upper and lower subscapular nerves (C5, C6, posterior cord). Functionally, the subscapularis provides both passive and active stability to the glenohumeral joint, acting as a key anterior stabilizer, especially in the middle range of humeral abduction. It also plays a role in internal rotation and assists in various movements like abduction, adduction, extension, and flexion, depending on the arm's position. Like the two spinate, subscapularis and teres major acts as a single functional unit. [15]

Supraspinatus muscle

The supraspinatus muscle originates from the supraspinous fossa and fascia, converging into a thick tendon that attaches to the greater tubercle of the humerus. Its footprint measures approximately 23mm in length and 16mm in width, with the infraspinatus tendon overlapping its posterior border. The supraspinatus forms a crucial anterior pillar in the posterosuperior rotator cuff.[11]

The supraspinatus muscle receives its blood supply from the suprascapular and dorsal scapular arteries and is innervated by the suprascapular nerve (C5, C6). Its primary function is to initiate shoulder abduction and assist the deltoid in further abduction, while also stabilizing the humeral head in the glenoid fossa as part of the rotator cuff. The term "footprint" refers to the specific insertion pattern of rotator cuff tendons, a concept introduced by Curtis et al. in 1999.

Infraspinatus muscle

The infraspinatus muscle is a triangular, thick muscle occupying most of the infraspinous fossa. It originates from the medial two-thirds of the fossa and inserts onto the middle facet of the greater tubercle of the humerus via a tendinous attachment.. The trapezoid footprint has an average length of 29 mm and width of 19 mm. [11] The infraspinatus tendon merges with the supraspinatus tendon lateral to the scapular spine. It receives its blood supply from the suprascapular and circumflex scapular arteries and is innervated by the suprascapular nerve (C5, C6). Functionally, the infraspinatus acts as an external rotator of the humerus and stabilizes the glenohumeral joint, preventing posterior subluxation.

Teres minor

The teres minor muscle originates from the upper two-thirds of the scapula's dorsal surface near its lateral border and inserts onto the lowest facet of the greater tuberosity. It receives blood supply from the circumflex scapular and posterior circumflex humeral arteries and is innervated by a branch of the axillary nerve (C5, C6). Teres minor is a main external rotator and a weak adductor of the humerus and a glenohumeral stabilizer.[11]

DYNAMIC STABILIZERS

Surprisingly, the shoulder girdle's suspensory stability relies minimally on active or passive muscle activity at rest. EMG studies show that muscles like the deltoid, pectoralis major, serratus anterior, and latissimus dorsi are inactive when the arm hangs freely at the side.

PASSIVE MUSCLE TENSION

The passive role of muscle bulk in joint stability is shown by the increased range of motion when muscles are removed. Research by Howell and Kraft found that paralyzing the supraspinatus and infraspinatus muscles via a suprascapular nerve block still maintained normal kinematics in most shoulders (45 out of 47).

COMPRESSION OF THE ARTICULAR SURFACE (CONCAVITY-COMPRESSION EFFECT)

The glenoid's concave surface provides stability when the humeral head is compressed against it, requiring significant force to dislocate. This concavity-compression effect, influenced by glenoid depth and compressive force, resists lateral translation of the humeral head, thereby stabilizing the joint. The greater the compressive force, the stronger the resistance to dislocation.

DYNAMIC CONTRACTION

Research showed that in stable shoulders, the supraspinatus and infraspinatus are equally important for stability, but in unstable shoulders, muscle importance varies. Muscle balance is crucial, as altering it increases instability. The dynamic stability index measures stability through shear and compressive forces. Different rotator cuff muscles provide stability in different ranges of motion, with the subscapularis, infraspinatus, and teres minor being key in end ranges, and the supraspinatus and subscapularis important in midranges. Overall, the rotator cuff provides significant dynamic stability throughout shoulder motion.

DELTOID

The deltoid muscle's origin from the acromion plays a crucial role in shoulder stability. A laterally extending acromion can lead to rotator cuff tears due to the deltoid's superiorly oriented force, causing humeral migration and impingement. Conversely, a more medial acromion positions the deltoid's force medially, stabilizing the humeral head. The rotator cuff, formed by the tendons of four muscles, functions as a continuous unit near its insertion, working together to provide normal joint movement. A cable-like structure within the rotator cuff, known as the rotator cable, helps distribute stress and shield weaker areas. The primary function of the rotator cuff is to balance force couples around the glenohumeral joint, ensuring stable movement. This balance involves the coronal plane force couple (deltoid vs. inferior rotator cuff) and the transverse plane force couple (anterior vs. posterior cuff). Tears affecting most of the anterior or posterior cuff can disrupt joint kinematics, emphasizing the importance of balancing these force couples for stable shoulder motion. [17]

FUNCTION OF THE ROTATOR CUFF

At the distal aspect of the rotator cuff, the supraspinatus and infraspinatus tendons splay out and interdigitate, forming a common continuous insertion on the middle facet of the humeral greater tuberosity. The rotator cuff is a complex, laminated structure composed of the joint capsule, ligaments, and four tendons that interdigitate to form a continuous hood at their insertion points on the humerus. This arrangement allows loads from one muscle to be dispersed to adjacent tendons, making the rotator cuff a functional unit. Injury to one part can impact other regions, highlighting the interconnected nature of the rotator cuff.

Initiation of shoulder abduction relies on the function and integrity of the supraspinatus muscle and tendon and other rotator cuff tendons [11]. The supraspinatus plays a crucial role in initiating abduction, and without it, the deltoid muscle must compensate with increased force. Large rotator cuff tears can severely limit abduction. The rotator cuff also significantly contributes to shoulder rotation, with the infraspinatus as the primary external rotator and the subscapularis as a key internal rotator

The rotator cuff provides significant dynamic stability to the glenohumeral joint throughout its range of motion. The tendons of the rotator cuff are positioned around the joint, with the supraspinatus tendon situated between the acromion and humeral head, inserting into the greater tuberosity. The infraspinatus and teres minor tendons are located posteriorly on the greater tuberosity, while the subscapularis tendon runs anteriorly, attaching to the lesser tuberosity.

The supraspinatus muscle acts with the deltoid muscle to abduct the arm. The subscapularis muscle runs anterior to the shoulder, and its tendon attaches to the lesser

tuberosity. The length of the subscapularis tendon and muscle can be shown best on axial images. Its attachment blends with the transverse humeral ligament which bridges the lesser and greater tuberosities and holds the long head of the biceps tendon in the bicipital groove

The rotator cuff tendons have cylindrical and flat portions that interdigitate, forming a continuous tendinous hood at their insertion points on the humerus. Notably, these tendons lack synovial sheaths or surrounding paratenon.

MECHANISM OF INJURY

Rotator cuff tears often involve a combination of extrinsic factors (such as impingement, overload, and repetitive stress) and intrinsic factors (like poor vascularity, aging, and changes in tendon composition). While trauma may trigger symptoms, it's rarely the sole cause, and the exact contribution of these factors to tear development remains unclear.

Subacromial impingement and tendon degeneration are the two main causes of rotator cuff tears. Neer suggested that the coracoacromial arch's shape contributes to cuff disease, with the anterior acromion, coracoacromial ligament, and AC joint potentially compressing the cuff. Bigliani's cadaver study classified acromion shapes into three types: flat (17%), curved (43%), and hooked (40%). Curved and hooked acromions were associated with more cuff tears. While debate continues over whether acromion shape is a primary cause or secondary effect, abnormal contact likely exacerbates cuff dysfunction and hinders repair.

The degenerative changes associated with rotator cuff tears have been well documented. Various authors have demonstrated these pathologic changes (e.g.,disruption, disorganization and thinning of collagen fascicles, dystrophic calcifications, formation of

granulation tissue) and have correlated the presence of these findings with a significant decrease in the ultimate tensile strength of the supraspinatus tendon insertion. Thus, in patients with a degenerative rotator cuff, trivial trauma (e.g., lifting a box) can lead to a complete tear.

PHYSICAL EXAMINATION

Subscapularis pathology can often be diagnosed via clinical examination alone. [18] The surgeon must assess the biceps tendon for pathology, it occurs concomitantly with injury to the subscapularis due to the intimate nature of these anatomical structures. Assessment of the posterosuperior cuff and acromioclavicular (AC) joint are included.

A thorough physical examination for shoulder issues involves several key components:

1. Inspection: Visually examining the shoulder for any deformities, swelling, or asymmetry.

2. Range of Movement (ROM): Assessing both active (patient moves their own shoulder) and passive (examiner moves the patient's shoulder) ROM in various directions, including:

- Internal rotation (IR)

- External rotation (ER)

- Forward elevation

Any limitations or differences compared to the unaffected side are noted. Patients with large full-thickness tears of the subscapularis may exhibit increased passive external rotation.

3. Palpation: Checking for tenderness in specific areas, such as:

- The AC (acromioclavicular) joint

- Coracoid process

- Long head of the biceps tendon

- Lesser tuberosity

The position of the biceps muscle belly is also observed; if ruptured, it may appear more distally.

4. Strength Testing: Specifically for internal rotation (IR) strength:

- The patient places their hand on their abdomen and brings their elbow forward.

- The examiner then attempts to pull the patient's hand off their abdomen while applying external rotation at the elbow.

5. Special Tests: Additional maneuvers may be performed to assess specific shoulder functions or reproduce symptoms.This comprehensive examination helps in identifying the underlying issues and guides further diagnosis and treatment\

Table 1 : Physical examination findings

Test	Positive finding
Passive ER	Increased ER versus contralateral normal shoulder
IR strength	Weakness
Belly-press	Inability to keep elbow in line with or in front of trunk
Napoleon's sign	Inability to exert pressure on the abdomen
Lift-off test	Inability to lift the hand off the back
Modified lift-off test	Inability to maintain hand off the back when lifted away by the examiner
Bear Hug Test	Inability to maintain contact on the opposite shoulder against resistance.

SPECIAL TESTS

Numerous specific tests identify tears of the subscapularis. Gerber and Krushell[19] first described the 'lift-off' technique, where the arm is internally rotated behind the torso with the elbow flexed. subscapularis tearing is unable to lift the dorsum of the hand off the back. A modified version of this special test requires the patient to lift the hand off the back against the resistance applied by the examiner. [19] The test is positive when the patient is unable to maintain position of hand off of back.

In order to adequately assess the patients with limited IR or extreme pain limiting the utility of the lift off test, Gerber et al [19] also described the belly – press technique. The patients presses the abdomen with the hand flat, keeping the shoulder in IR and maintaining the elbow at or in front of the mid coronal place of the trunk. A positive test in when the elbow drops back behind the trunk. The examiner can elicit positive sign with a posteriorly directed force on the elbow. The napoleon sign is when the elbow falls back and the wrist flexes, the position in which Napoleon Bonaparte held his arm during the portraits. [20] The near hug test had proved sensitive for tears of the subcapularis [21] The patients hand is placed across the body on top of the opposite shoulder with the elbow elevated and the examiner attempts to pill the hand off the shoulder. The test is considered positive if the examiner is able to lift the patients' hand off the shoulder.

IMAGING

A thorough shoulder examination involves inspection, assessing range of motion (ROM), evaluating internal rotation strength, and performing special tests. The examiner checks for tenderness in areas like the AC joint, coracoid, biceps tendon, and lesser tuberosity, and notes the biceps muscle's position. Both active and passive ROM are evaluated in internal rotation, external rotation, and forward elevation, comparing to the unaffected side. Internal rotation strength is tested by having the patient place their hand on their abdomen and resist the examiner's attempt to pull it away while rotating the arm externally.Using a combination of axial, sagittal and coronal planes, MR imaging has a high sensitivity and specificity for diagnosing lesions of the subscapularis.[22,23]

It has recently been suggested that tear size correlates to MR imaging sensitivity, with larger tears having higher sensitivity than smaller tears.[23] Axial imaging is particularly useful for detecting subscapularis tears. Coronal and sagittal images help further characterize the tear, including its extent, type (such as partial or full-thickness), and location. Coronal views can show the cranio-caudal extent of the tear and may reveal fluid signal near the coracoid, indicating subscapularis tearing.

Narrowing of the coracohumeral interval < 7 mm can also be indicative of tearing of the subscapularis. Lastly, the degree of muscle atrophy and retraction or the presence of edema should be carefully evaluated and are best seen on axial and sagittal images. Biceps subluxation, dislocation and/or tearing are consistently found as a result of the intimate association of the subscapularis, biceps sheath and coraco humeral ligament. [24] Medial dislocation of the biceps tendon is considered by many to be diagnostic of tearing of the subscapularis,[22] although there are rare circumstances of the biceps dislocating anterior to an intact subscapularis tendon.“

MRI helps identify biceps pathology and rotator cuff tears, aiding in pre-operative planning. It also detects cystic changes or defects in the lesser tuberosity that could affect anchor fixation. In some cases, CT arthrogram or ultrasound may be used for diagnosis. Ultrasound can also be useful for post-operative follow-up to check suture anchor placement and integrity.

CLASSIFICATION

There is no universally agreed-upon classification system for subscapularis tears. However, some commonly used systems are based on the tear's location and extent, such as

dividing the tendon into thirds (superior, middle, and inferior) or classifying tears relative to the biceps sling and superior glenohumeral ligament. (16,17,25-28]

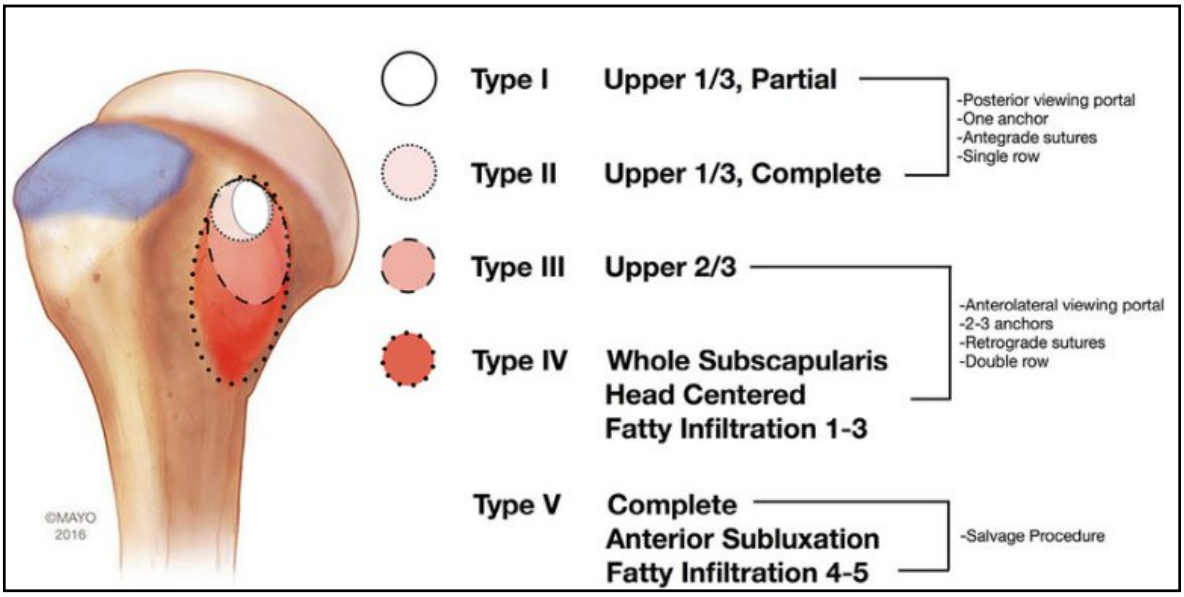


Fig 5 : Lafosse Classification of Subscapularis Tear.

INDICATIONS FOR REPAIR

Indications for subscapularis repair include a patient with a painful shoulder with evidence of a full thickness subscapularis tear or a partial thickness tear which has failed non-cooperative treatment. Contraindications to repair include pain free, grade 4 Goutallier fatty degeneration on MR imaging, glenohumeral arthropathy, infection, the non-compliant patients and significant medical comorbidities precluding anesthesia [29]

There has been some debate over repair of chronic subscapularis tears. The tendon edge does retract further medially than in tears of the posterosuperior rotator cuff [30,31] We believe that subscapularis tendon repair should be attempted whenever possible, especially in

physically active individuals with a dominant arm, as the tendon can be mobilized with necessary releases, and there are no contraindications.. The subscapularis has been suggested to function as an anterior restraint and contribute to elevation of the arm. Thus, even in the setting of fatty degeneration an argument for repair can be made. [32,33] in addition with combined tears of the rotator cuff, repair of the subscapularis facilitates repair of the posterosuperior rotator cuff and reduces tension on the complete repair construct [34,35]

SURGICAL TECHNIQUE

A standard set of instruments is required to perform a successful repair of the subscapularis. Key instruments used in subscapularis repair include:

1. Mobilization tools: straight and angled elevators, electrocautery, and ablation wands.

2. Suture passing instruments: straight and curved suture hooks, piercing instruments, and anterograde suture passers.

3. Suture management: atraumatic suture retrievers.

4. Fixation: knot-tying tools or knotless repair options, such as single-row fixation..

The preferred technique is to used 30 degree scope with adjusting arm position as needed for visualization and have found little need for a 7- degree scope. However, the latter may be used to aid visualization in difficult cases. [36]

IMPLANTS [37]

For subscapularis repair, anchors like absorbable biocomposites or PEEK can be used, but metal anchors may offer advantages due to their single-step insertion, reducing potential

angle mismatch and fixation loss. Double-loaded anchors with high-tensile suture are often preferred to simplify suture management in limited spaces..

The number of anchors used in subscapularis repair depends on the extent of the tendon tear. For example:

- A small tear (33% or upper third) may require one double-loaded anchor.

- A large tear (50-66%) might need two double-loaded anchors or one triple-loaded anchor.

- A complete tear (100%) typically requires two double-loaded anchors.

Sutures are usually passed in a simple fashion, but can be configured as a horizontal mattress if needed. Single-row knotless and double-row techniques are options, but are used less frequently.

ARTHROSCOPE

An arthroscope is an optical instrument. Three basic optical systems have been used in rigid arthroscopes: [38] the classic thin lens system,[39] the rod-lens system designed by Professor Hopkins of Redding, England, and [40] the graded index (GRIN) lens system. Fiberoptic technology, the use of magnifying lenses, and digital monitors has allowed advancements in arthroscope design. Newer arthroscopes offer an increased field of view with smaller scope diameters, better depth of field with improved optics, and better flow through the sheath.

The optical characteristics of an arthroscope are determined by its diameter, angle of inclination, and field of view. The angle of inclination, which ranges from 0 to 120 degrees,

affects the viewing perspective. Commonly used angles include 25 and 30 degrees, while 70 and 90-degree scopes are useful for visualizing hard-to-reach areas but can be challenging for orientation.

The field of view in arthroscopy refers to the angle of visualization provided by the lens, with wider angles facilitating easier orientation. Different arthroscope sizes offer varying fields of view:

- 1.9-mm scope: 65 degrees
- 2.7-mm scope: 90 degrees
- 4.0-mm scope: 115 degrees

Rotating the arthroscope, especially forward oblique (25-30 degrees), expands the observable area, while rotating larger angle scopes (70-90 degrees) can create a large field of view but may introduce a central blind spot.

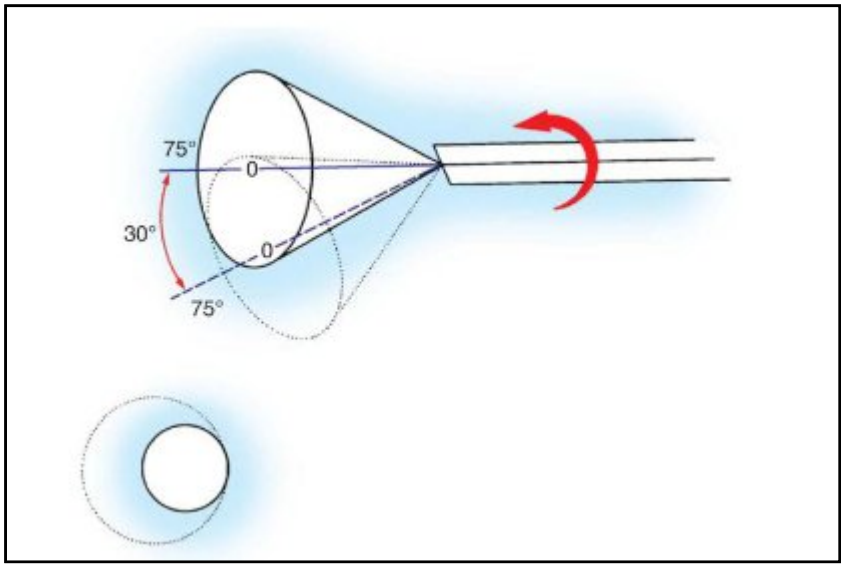


Fig 6 : Rotation of arthroscope with 30-degree angle of inclination, which causes scanning effect that increases field of view by about three times. Dotted circle shows field of view and is compared at lower left with small circle that shows field of view of 0-degree arthroscope.

Arthroscopes come in various diameters, ranging from 1.7 to 7 mm, with 4 mm being the most commonly used size. Smaller scopes (1.9-2.7 mm) are ideal for smaller joints like the wrist and ankle. Additionally, small-diameter, flexible "steerable" arthroscopes are available for use in tight spaces and office-based procedures under local anesthesia, though they may compromise image quality and field of view provided by these instruments need improvement. Two arthroscopic instrument designs are available, one for viewing and one for operating. The operating arthroscope, developed by O'Connor, allows direct viewing, with a channel for the placement of operative instruments in line with the arthroscope. The advantages of this system are that the tip of the instrument is directly in the field of vision, and only one portal is required for the passage of two instruments. Because it requires a large-diameter sheath (7.5 mm), it

is impractical for smaller joints. The development of triangulation techniques through the viewing arthroscope has reduced the operating arthroscope to a historical curiosity.

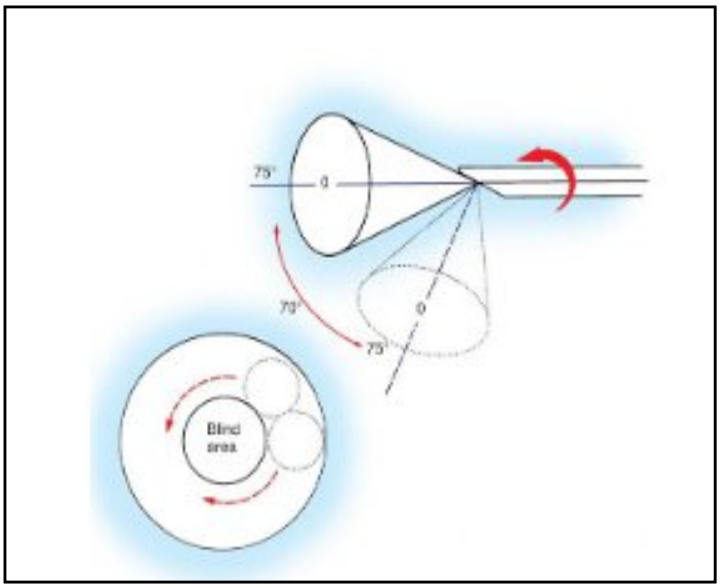


Fig 7: Rotation of arthroscope with 70-degree angle of inclination. This scans large circle but creates blind area directly ahead of it in which nothing can be seen.

MINI OPEN ROTATOR CUFF REPAIR [41-43]

Mini operator cuff repair [MOCR] is a procedure that is used to examine the rotator cuff in the shoulder and to repair torn tendons. The procedure involves an arthroscopic examination using a small camera inserted through tiny incisions. Depending on the extent of damage, treatment options range from minimally invasive repairs to open surgery for more severe cases requiring tendon reattachment.

Rotator cuff injury is very common and painful. People working and performing work repetitively applying stress on the cuff tendons. Works like extensive arm lifting, people above

40 years of age are potential sufferers from a rotator cuff tear. Symptoms include arm weakness, pain when lifting or making specific movements, rotating arm and pain when resting on affected shoulder and crackling sensation in shoulder when performing certain movements. In such people, rotator cuff repair becomes very important. Surgical techniques like arthroscopy, open surgery or sometimes combination of both is required. One arthroscopy technique is mini rotator cuff repair.

Steps for MOCR

a. Insertion of arthroscope

   Once the patient is ready, a small incision in the shoulder is made. A camera called arthroscope is inserted into the joint vial the small incision.

b. Debridement of the joint

   During arthroscopy, once a clear view of the shoulder joint is obtained, specialized tools are inserted to perform debridement, removing debris and loosening tendon fragments from the rotator cuff. After cleaning, the joint is further inspected via the arthroscope to determine the next steps in treatment..

c. Smoothing the acromion

   If bones spurs are found at the bottom of the acromion, smoothening them down with the rasp like tool in a procedure called subacromial decompression is done. This is performed to help and prevent the acromion from impinging upon the supraspinatus tendon.

d. Examining the Rotator Cuff

   Once any debridement or smoothing has been completed, examining the rotator cuff is done to determine the extent of any tearing. If no tears are found, this may be the last

step of the procedure. However, if tears are found, further examination is done to determine the best repair option. If the tear is small, it may be repairable using arthroscopic tools. Larger tears may require to make a 2 to 3 inch open incision. Once the tear's severity has been determined, cleaning up the torn end of the tendon and an area on the humerus is done.

e. Inserting the Anchors

Then, a drill or other tool is used to create one or more small holes in the cleaned area of the humerus. Then the anchors are inserted into these holes. These anchors are placed to hold the stitches to the bone.

f. Suturing the Tears

After anchors have been placed, reattaching the tendon to the humerus by stitching together the torn tendon and pulling the sutures against the anchors is performed.

g. Ending the Procedure

All tools are removed, and all incisions are closed. The arm is then placed into a sling.

INSTRUMENTS USED

A basic arthroscopy instrument kit typically includes:

- Arthroscopes (30° and 70°)

- Probe

- Scissors

- Basket forceps

- Grasping forceps

- Arthroscopic knives

- Motorized shaver and cutter

- Electrosurgical, laser, and radiofrequency instruments

Additional specialized instruments are available for specific procedures, such as ligament reconstruction or small-joint arthroscopy, and surgeons often have personal preferences for instrument type and design.

Fig 8: Arthroscopic probe used in exploring intra articular structures during arthroscopic triangulation techniques

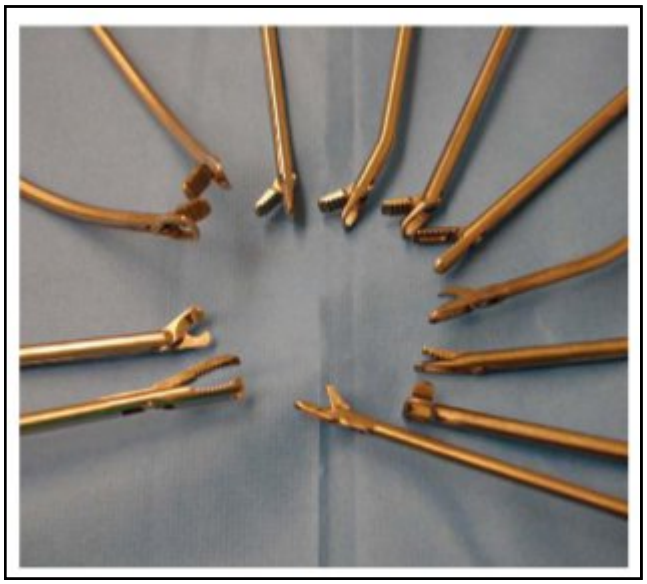


Fig 9 : Commonly used arthroscopic instruments

Fig 10 : Motorized shaver system

ASSESSMENT OF ROTATOR CUFF MOBILITY AND TEAR PATTERN

The mobility of the rotator cuff tear is assessed using a tendon grasper to determine if the tear can be repaired directly to bone. The grasper is inserted through the lateral portal, and the medial margin of the tear is pulled laterally toward the bone bed. If the tear can be brought

to the bone with minimal tension, it's classified as crescent-shaped and suitable for direct repair.

For tears with limited medial-to-lateral mobility, anterior-to-posterior mobility is assessed. The arthroscope is placed in the lateral portal, and a tendon grasper is used to test the mobility of the tear margins. If the anterior and posterior leaves can be brought into contact, the tear is classified as U-shaped and can be repaired with side-to-side sutures using margin convergence..

L-shaped tears are similar to U-shaped tears but have one leaf (often posterior) with significantly more mobility. Treatment involves side-to-side sutures along the longitudinal tear component, followed by repairing the converged margin to bone.

REPAIRS FOR DIFFERENT TYPES OF TEARS [44,45]

Repair of Crescent-Shaped Tears

After identifying a crescent-shaped tear and performing a subacromial decompression, the bone bed on the humeral neck is prepared, just off the articular margin, using the 5-mm Resector shaver. Decortication of bone should be avoided, because this can weaken anchor fixation. It has been shown that a bleeding bone surface rather than a bone trough is all that is required for satisfactory healing of tendon to bone.

For rotator cuff fixation to bone, BioCorkscrew suture anchors (Arthrex) double-loaded with #2 Ethibond or #2 Fiberwire are preferred. The anchor's flexible loop eyelet allows smooth suture sliding, reducing fouling and abrasion.

Repair of U-Shaped Tears

For U-shaped rotator cuff tears, margin convergence with side-to-side sutures is performed after subacromial decompression and bone bed preparation. The arthroscope is placed in the lateral portal, providing a clear view of the tear. Two methods are commonly used for passing side-to-side sutures, depending on the approach angle and assistant availability.

Repair of L-Shaped Tears

For L-shaped rotator cuff tears, side-to-side sutures are placed sequentially from medial to lateral, taking into account the mobility of the leaves. The surgeon determines the "corner" of the L and places sutures obliquely to shift the more mobile leaf (usually posterior) anteriorly and laterally, or vice versa if the anterior leaf is more mobile..

POSTOPERATIVE MANAGEMENT

Arthroscopic rotator cuff repairs are outpatient procedures. Post-op care involves wearing a sling with a pillow continuously for 6 weeks, except during bathing and exercises. Rehabilitation programs vary, but for subscapularis repairs, passive external rotation is limited to 0 degrees for 6 weeks. In addition, terminal extension of the elbow is restricted if a biceps tenodesis was performed

Table 2: Rehabilitation protocol following Mini rotator cuff repair

Time Period	Rehabilitation

Zero -6 week	Immobilization: sling Elbow/wrist: active ROM Shoulder: passive external rotation in adduction only
6-12 weeks	Shoulder: active ROM, avoid lateral abduction94 Stretching: forward flexion, internal rotation, external rotation
>12 wk	Strengthening: deltoid, biceps, triceps, rotator cuff, scapular stabilizers
>6 months	Normal activities

EVIDENCES SUGGESTING THE FUNCTIONAL EVALUATION OF SHOULDER FOLLOWING MINI OPEN ROTATOR CUFF REPAIR

Daga S et al in 2024, [46] evaluated the differences between all-arthroscopic (AA) and mini-open (MO) repair procedures for rotator cuff tendon tears regarding clinical and functional outcomes. A study compared outcomes of all-arthroscopic and mini-open rotator cuff repair surgery in 50 patients. Both groups showed significant improvement in UCLA scores, with arthroscopic patients experiencing faster pain relief. However, long-term results showed no significant difference in pain, range of motion, or patient satisfaction between the two groups

Aswin Dev et al in 2023 [47] conducted a comparative study of functional outcomes among 114 patients who underwent all arthroscopic in 57 and mini open in 57 repair. After Procedures were done using standard techniques by the treating physician. The study found that modified ASES scores improved from - 35.47 (pre-op) to 64.56 (6 months) and 75.42 (12 months) in the mini-open repair group. - 39.74 (pre-op) to 65.39 (6 months) and 74.17 (12 months) in the arthroscopic repair group. The differences between groups were not statistically significant, with p-values of 0.798 at 6 months and 0.756 at 12 months, indicating similar functional outcomes for both mini-open and arthroscopic rotator cuff repair surgeries..

Mohammed Idress Shah et al in 2023, [43] investigated the functional outcomes of Mini-Open Rotator Cuff Repair comparing it with Arthroscopic rotator cuff repair surgery. Their study included 20 patients, with an average age of 55 years, who underwent either open or arthroscopic rotator-cuff repair surgery. Most patients returned to work and daily activities 3 months post-surgery, with 100% range of motion achieved. Both groups showed good/excellent outcomes based on CMS scores at 6 and 12 months. While most factors had insignificant p-values, median ASES scores increased significantly over time in both group

Navin Kumar H.C et al.,in 2019 [48] evaluated the functional outcome of patients who underwent arthroscopic assisted mini-open rotator cuff repair. Patients, aged 30 to 70 years, who had an isolated tear in the rotator cuff tendon were diagnosed by clinical examination & confirmed by MRI. The study included 26 patients with a mean age of 47.12 years who underwent arthroscopic-assisted mini-open rotator cuff repair. The most common injury cause was domestic falls (84.6%). Partial thickness tears occurred in 57.7% of patients. UCLA scores improved significantly from 12.42 preoperatively to 29.46 at 6 months, and SF-

36 scores also showed significant improvement in all subscales, indicating enhanced physical and mental quality of life.

Vikas Sharma et al in 2018 [49] aimed to assess functional outcome of mini-open rotator cuff repair of shoulder joint in adult patients. A total of 20 patients diagnosed to have rotator cuff tear of shoulder joint undergoing rotator cuff repair were enrolled. 30%of the patients were aged between 31 to 40 years. The study included patients with a mean age of 41.90 years, where 45% had degenerative rotator cuff tears and 70% presented with swelling. Significant improvements were seen from enrollment to 6-month follow-up in: - Flexion: 6.25° to 163.50°, - Abduction: 5.50° to 112.0°, - External rotation: 3.00° to 82.50°, - Internal rotation: 2.50° to 67.25°, - UCLA score: 5.35 to 29.60, - VAS score: 7.70 to 0.00. The study concluded that mini-open rotator cuff repair results in excellent functional outcomes with complete pain relief at 6 months.

Shepe et al in 2015, [50] compared the clinical outcomes following mini-open rotator cuff repair (MORCR) between early mobilisation and usual care, involving initial immobilisation. In total, 189 patients with radiologically-confirmed full-thickness rotator cuff tears underwent MORCR and were randomised to either early mobilisation (n = 97) or standard rehabilitation (n = 92) groups. A study compared early mobilization vs. immobilization after mini-open rotator cuff repair (MORCR). Early mobilization showed increased abduction and scapular plane elevation at 6 weeks, but differences disappeared by 3 months. At 24 months, clinical outcomes were similar between groups, suggesting rehabilitation choice can be left to patient and surgeon discretion.

MATERIAL AND

METHODS

MATERIAL AND METHODS

- **Study Duration**: They study was done for a period of 18 months
- **Source of Data** : Patients attending outpatient department of Orthopaedics of B.L.D.E. (DEEMED TO BE UNIVERSITY) Shri B.M.Patil Medical College, Hospital and Research Centre, Vijayapura were included
- **Study Design**: This is prospective study done in 40 patients with the diagnosis of rotator cuff tear
- **Sample Size**: With an anticipated Proportion of shoulder pain and rotator cuff tear 7 - 25% ,the study would require a sample size of 40 patients with 95% level of confidence and 8% absolute precision,

Formula used $\frac{n=z\ 2\ p*q}{d\ 2}$

Where Z= Z statistic at α level of significance

d 2 = Absolute error

P= Proportion rate

q= 100-p

- **Inclusion criteria**

    1. Age of the patient above 18 years
    2. Degenerative, traumatic, sports injury patients, diagnosed radiologically and clinically with rotator cuff tear of the shoulder

- **Exclusion criteria**

    1. Associated fracture of proximal 1/3rd humerus
    2. Previous surgery on the affected shoulder
    3. Severe glenohumeral osteoarthritis.

Methods of Data collection

Institutional Ethical Review Board approval was obtained prior to initiation of the study. All the patients fulfilling the inclusion criteria were included in the study after their consent of participating and willingness to undergo required investigations as a part of the study.

The data was captured in the case record form [CRF], that were broadly classified into

A. Demographic Characteristics: Name, age, sex, address, contact details, monthly income, languages known, occupation, educational level, rural/ urban, religion.

B. Patient history – history on trauma, fractures, personal history, family history, treatment history was noted

C. Clinical details – complaints with duration, present complaints and its history, mode of injury was noted down.

D. Clinical examination: general physical examination, vitals- BP,PR,RR, systemic examination, local examination of shoulder for deformity, abnormal swelling and

skin, palpitation for local tenderness, bony irregularity, movements – flexion, extension, abduction, adduction , internal rotation, muscle strength test and special tests like empty can, Gerber's test, belly press tests, drop arm sign were noted.

E. Treatment details – date of treatment, follow-up and side effects if any were noted.

F. Assessment tools and scoring: DASH score and ULCA score was used.

STATISTICAL ANALYSIS

Data is analyzed using SPSS software version 21 and Excel. Categorical variables are given in the form of frequency table. Continuous variables are given in Mean ± SD/ Median (Min, Max) form. Normality was checked by Shapiro wilk test. If the data follows normality then paired test and RM-ANOVA test are used. P-value less than or equal to 0.05 indicates statistical significance

RESULTS

RESULTS

Data contains measurements of 40 subjects with radiologically and clinically with rotator cuff tear of the shoulder.

The following tables provides the details.

Table 2: Distribution of subjects according to Socio-demographic details

Variable	Subcategory	Number of subjects (%)

Age	Mean ± SD	48.5 ± 14.79
	Median (Min, max)	50 (21, 70)
Gender	Female	16 (40%)
	Male	24 (60%)
Occupation	Homemaker	7 (17.5%)
	Labourer	8 (20%)
	Office worker	3 (7.5%)
	Retired	16 (40%)
	Sports person	6 (15%)

The mean of age was 48.5 ± 14.79 years. 24 (60%) subjects were male. 16 (40%) subjects were retired personal, 6 (15%) were sports person.

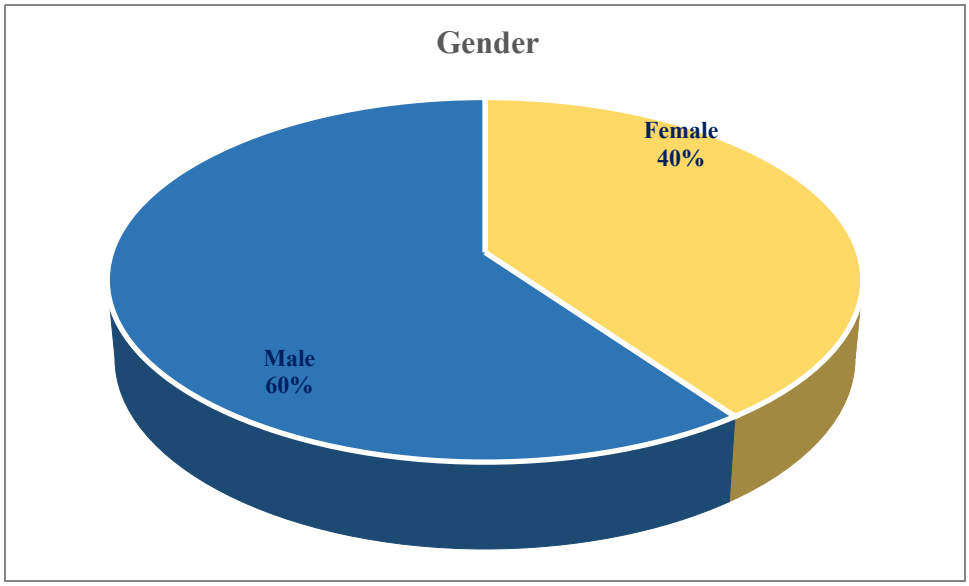


Figure 11: Distribution of subjects based on gender.

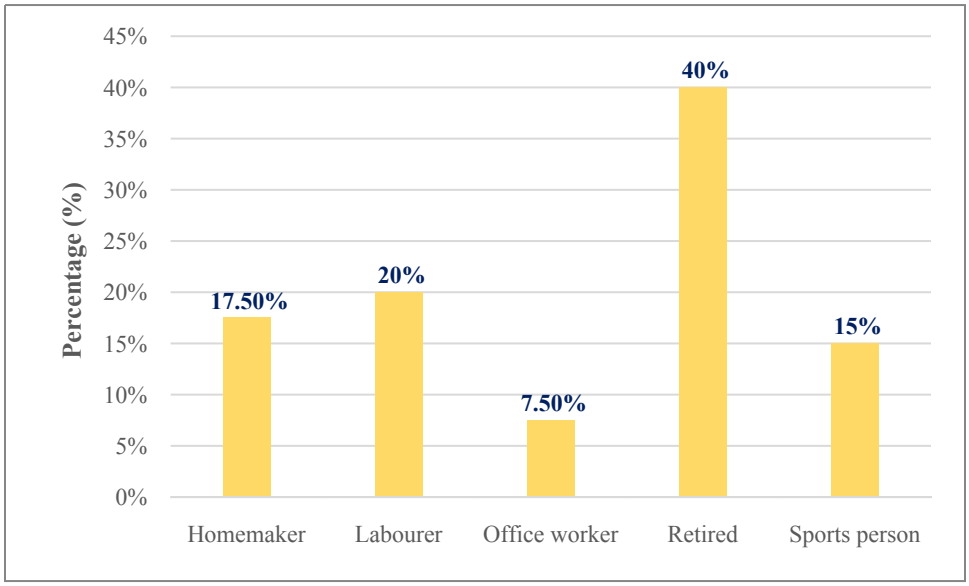


Figure 12: Distribution of subjects based on occupation.

Table 3: Distribution of subjects according to different variables of functional evaluation

Variables	Subcategory	Number of subjects (%)
Side affected	Left	21 (52.5%)
	Right	19 (47.5%)
Dominant side	No	18 (45%)
	Yes	22 (55)%
Duration of symptoms (months)	Mean ± SD	12.75 ± 7.08
	Median (Min, max)	14 (3, 24)
Mechanism of injury	Degeneartive	15 (37.5%)
	Sports	12 (30%)
	Traumatic	13 (32.5%)
Pre op VAS for pain	Mean ± SD	4.6 ± 3.12
	Median (Min, max)	4 (0, 10)
Tear size	Large	12 (30%)
	Massive	6 (15%)
	Medium	9 (22.5%)
	Small	13 (32.5%)

Complications	No	37 (92.5%)
	Yes	3 (7.5%)
Type of complication	None	40 (100%)

21 (52.5%) subjects had left side affected. The duration of symptoms was 12.75 ± 7.08 months. 15 (37.5%) subjects had degenerative type of injury. The mean of Pre OP VAS was 4.6 ± 3.12. 13 (32.5%) subjects had small tear size. 3 (7.5%) subjects had complications.

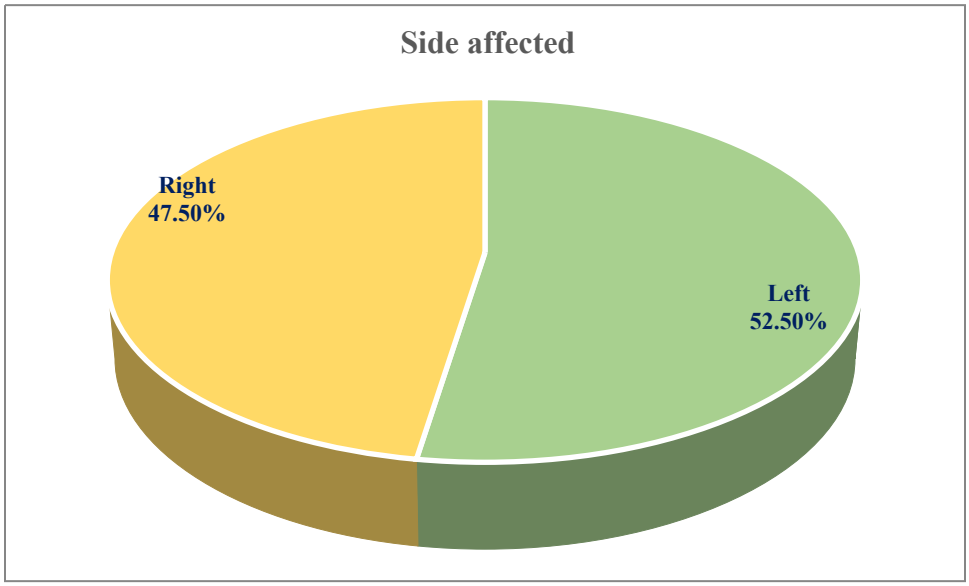


Figure 13: Distribution of subjects based on side affected.

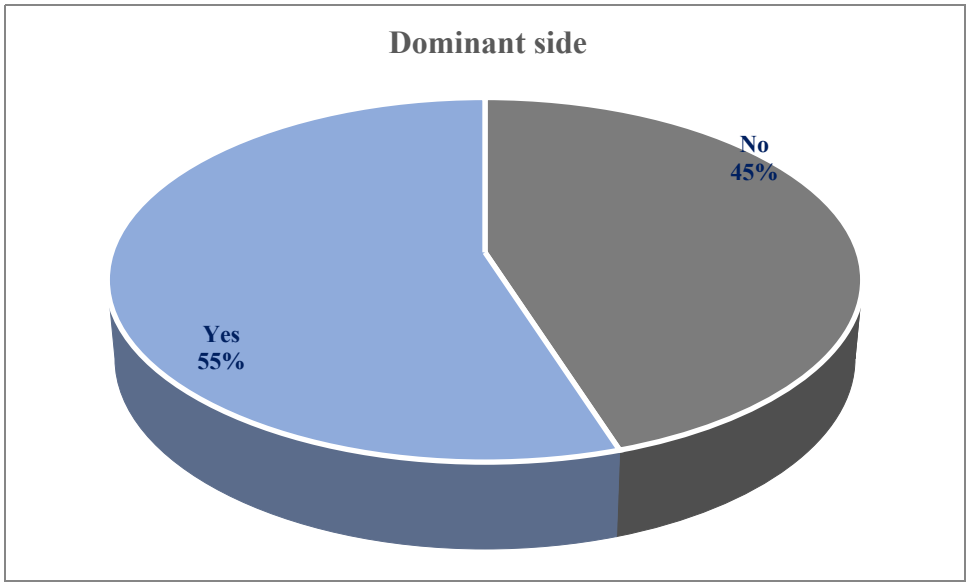


Figure 14: Distribution of subjects based on dominant side

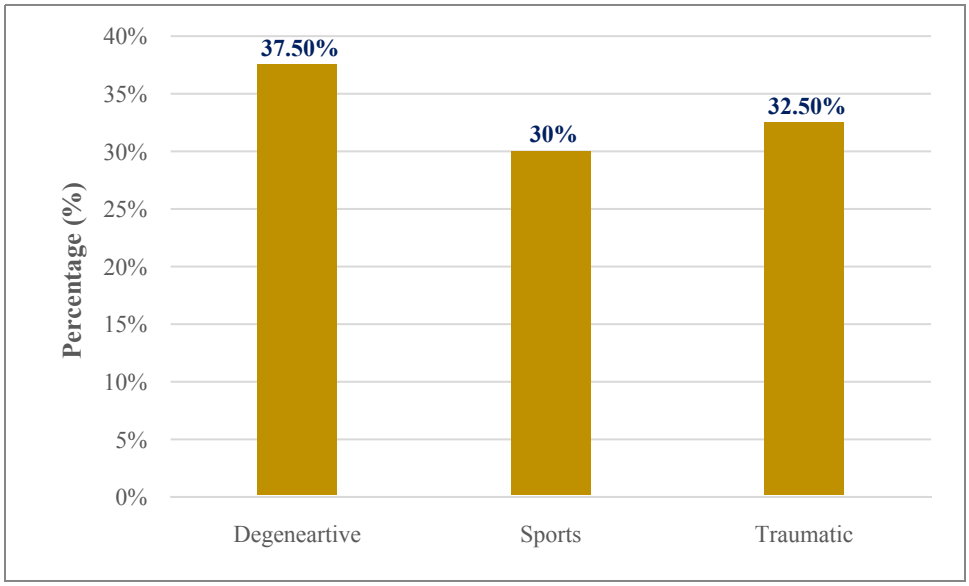


Figure 15: Distribution of subjects based on mechanism of injury

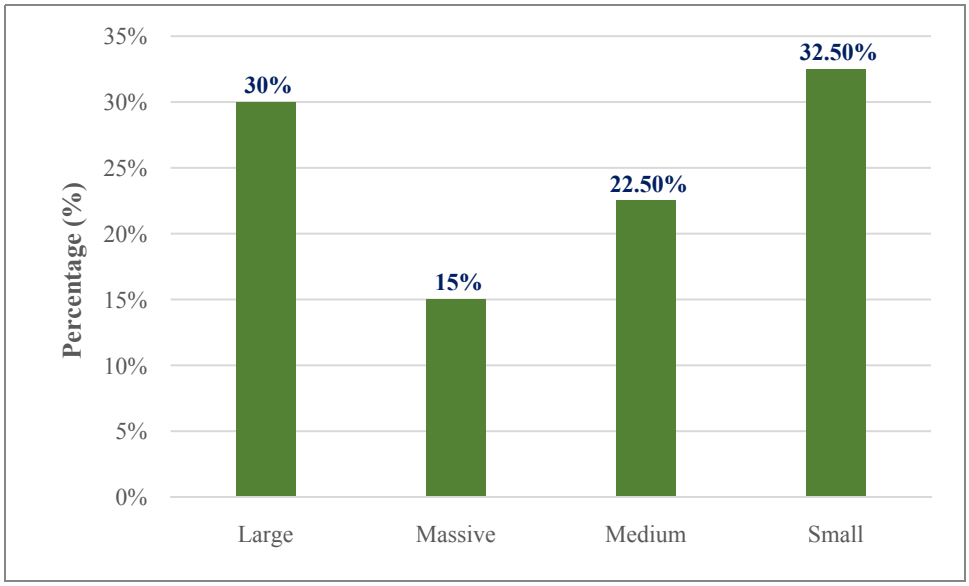


Figure 16: Distribution of subjects based on mechanism of injury

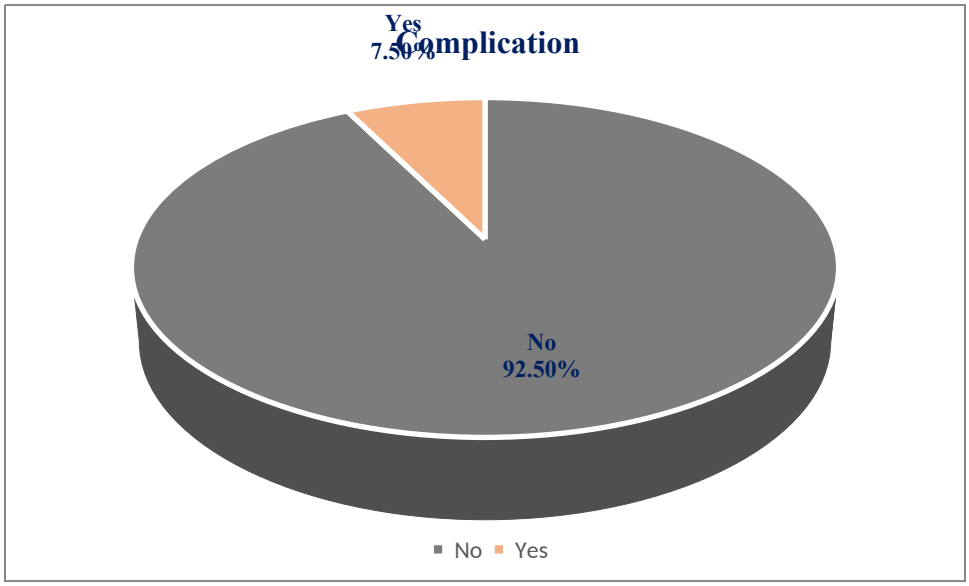


Figure 17: Distribution of subjects based on complication

Table 4: Distribution of subjects according to UCLA and DASH over intervals of time

Variable	Subcategory	Time intervals				p-value
		Pre OP	6 weeks	3 months	6 months	
UCLA	Mean ± SD	9.22 ± 1.65	17.55 ± 3.18	23.4 ± 3.6	27.07 ± 3.36	**<0.001*[RA]**
	Median (Min, max)	9 (6, 13)	17.5 (11, 23)	24 (15, 30)	27.5 (15, 32)	
DASH	Mean ± SD	72.9 ± 8.31	54.67 ± 10.53	39.17 ± 11.21	29.15 ± 11.76	**<0.001*[RA]**
	Median (Min, max)	72 (60, 85)	56 (35, 74)	39 (15, 64)	29.5 (5, 54)	

*Abbreviation: RM-ANOVA, *- indicates statistical significance*

From RM-ANOVA test, it can be observed that UCLA score significantly improves over time ($p < 0.001$). This suggests steady functional improvement over time. The DASH score significantly decreases over time ($p < 0.001$), indicating reduced disability. This confirms progressive recovery in arm, shoulder, and hand function.

From post hoc analysis, there was statistical significant differences in all comparisons in both UCLA and DASH.

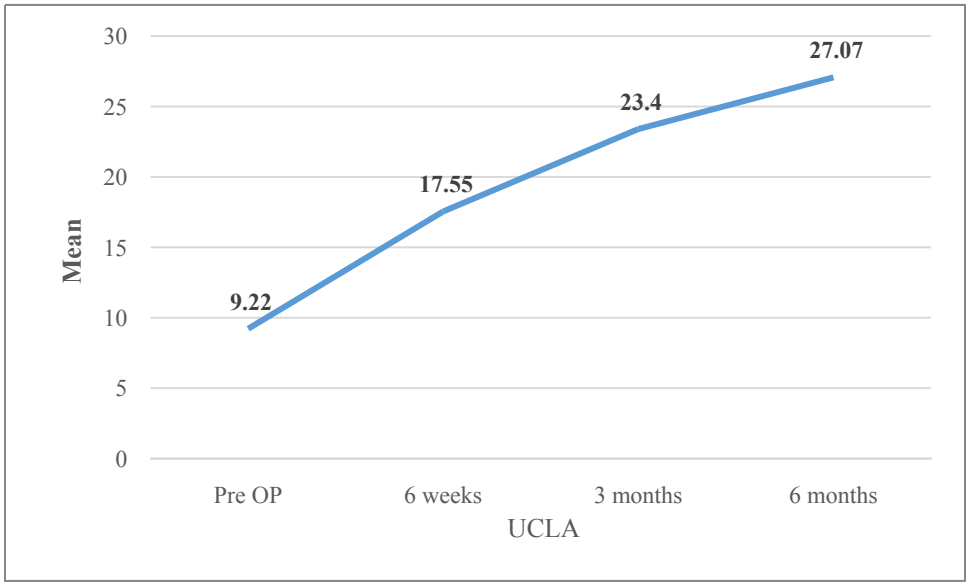


Figure 18: Mean plot of UCLA over time intervals

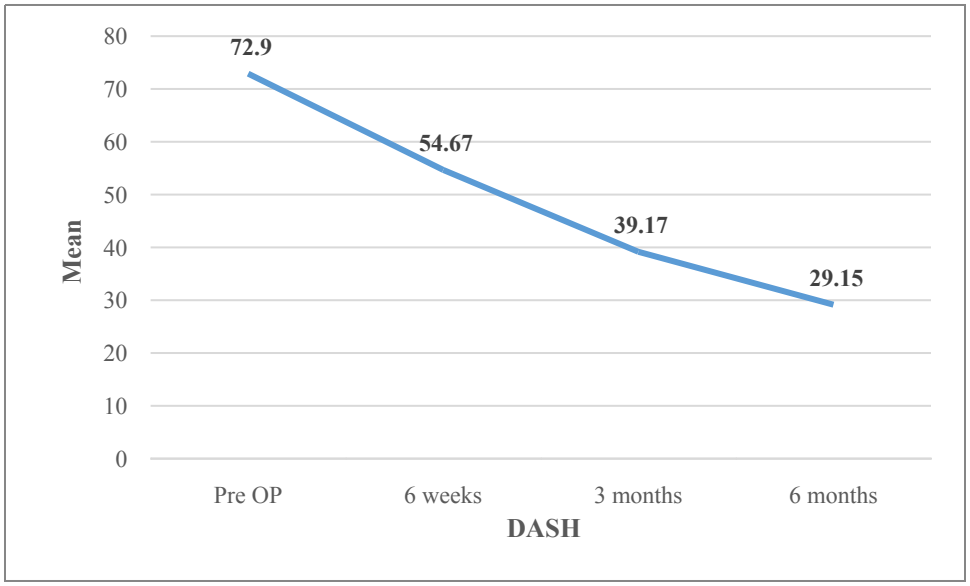


Figure 19: Mean plot of DASH over time intervals

Table 5: Pair wise comparision of means

Variable	Subcategory	Time intervals		p-value
		Pre OP	After 6 months	
Flexion	Mean ± SD	116.05 ± 14.78	151.05 ± 19.49	**<0.001*pt**
	Median (Min, max)	116.5 (90, 140)	152.5 (113, 180)	
Extension	Mean ± SD	28.97 ± 6.51	40.07 ± 7.04	**<0.001*pt**
	Median (Min, max)	28.5 (20, 40)	39 (27, 55)	
Abduction	Mean ± SD	97.45 ± 15.79	143.05 ± 17.09	**<0.001*pt**
	Median (Min, max)	97.5 (72, 118)	144 (112, 175)	
Internal rotation	Mean ± SD	36.35 ± 7.65	55.27 ± 9.79	**<0.001*pt**
	Median (Min, max)	36 (20, 50)	39 (32, 77)	
External rotation	Mean ± SD	24.97 ± 7.14	53.67 ± 11.12	**<0.001*pt**
	Median (Min, max)	25 (11, 39)	55 (33, 74)	

*Abbreviation: pt- paired t test, *- indicates statistical test*

From paired t test, it can be observed that, all shoulder movement parameters showed statistically significant improvement at 6 months postoperatively (**p < 0.001** for all).

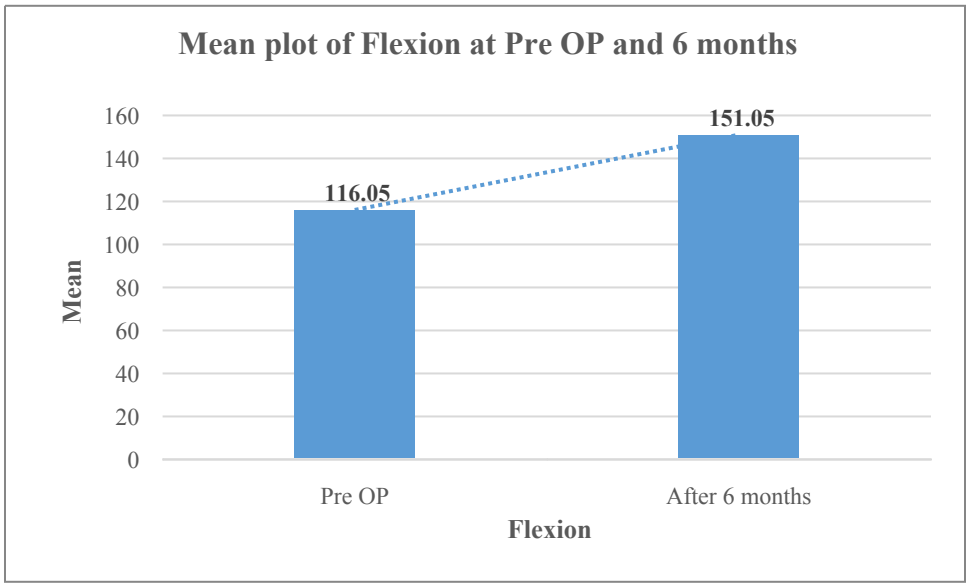


Figure 20: Mean plot of Flexion over time intervals

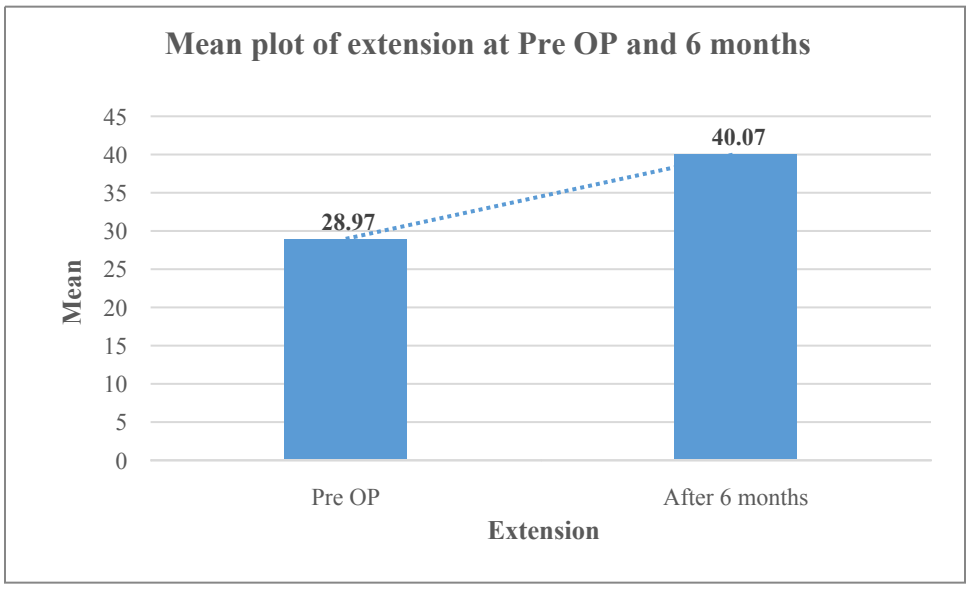


Figure 21: Mean plot of Extension over time intervals

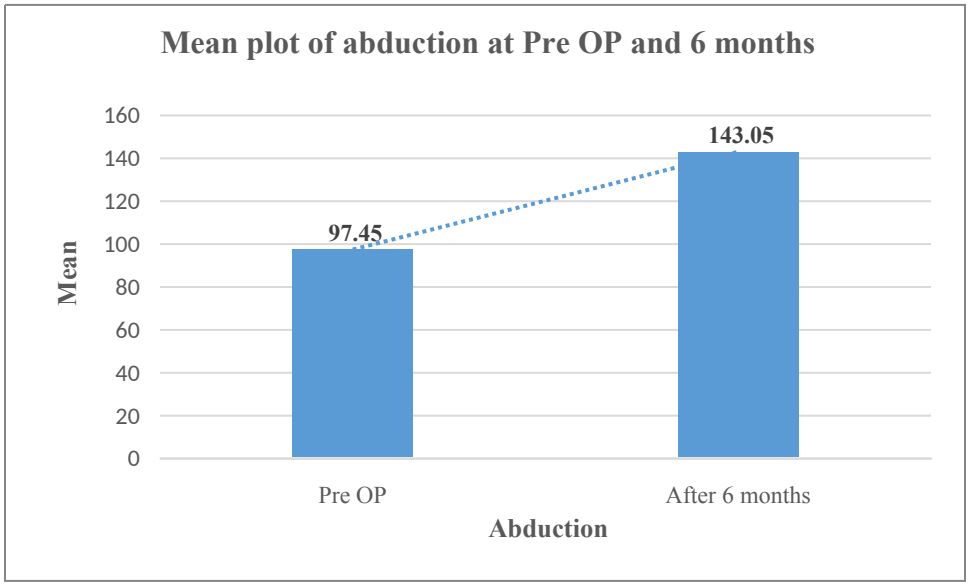


Figure 22: Mean plot of abduction over time intervals

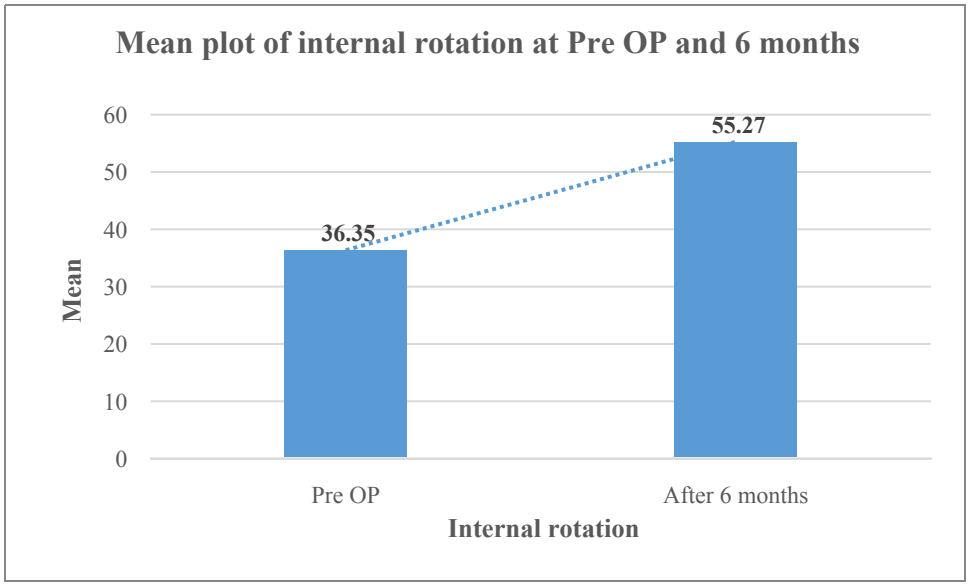


Figure 23: Mean plot of internal rotation over time intervals

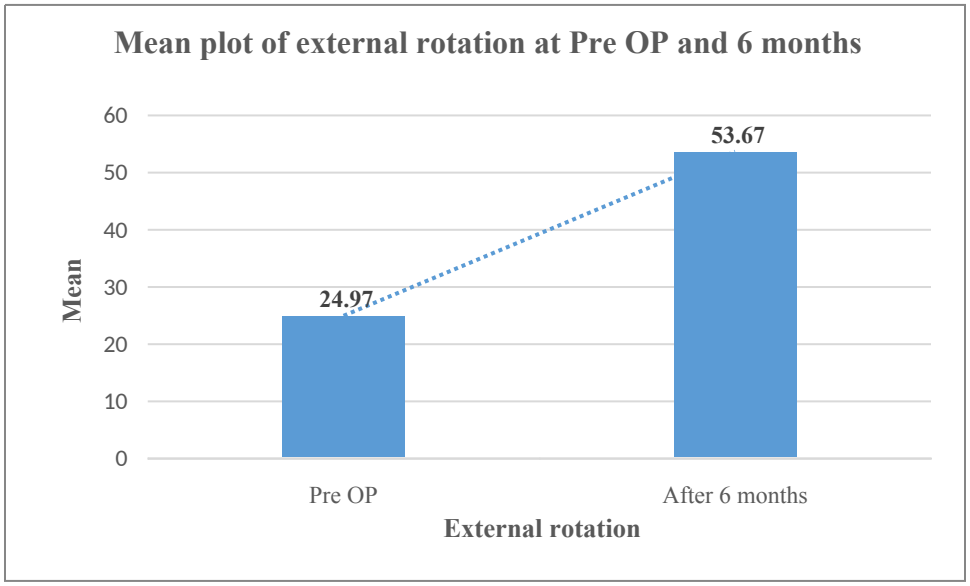


Figure 24: Mean plot of external rotation over time intervals

DISCUSSION

DISCUSSION

Shoulder pain is a common complaint among patients presenting with musculoskeletal disorders, with rotator cuff tears being one of the most prevalent problems, therefore, it requires early diagnosis and proper treatment. Rotator cuff tears may present with a variety of clinical features and the objective is to alleviate pain and improve function and strength of the affected

shoulder. First line of treatment for most tears is non-operative management, however, surgical repair is indicated when conservative management fails or in large tears. The choice of surgical technique can be arthroscopic or mini-open technique. Mini-open technique for rotator cuff repair has been the gold standard mode of treatment over the years, with a success rate of about 90% due to stronger suture fixation, potential advantage of decreased deltoid morbidity and a less steep learning curve for the surgeon compared to the arthroscopic technique.

Our data contains measurements of 40 subjects with radiologically and clinically with rotator cuff tear of the shoulder. The mean of age of our patients was 48.5 ± 14.79 years with 60% subjects being male. 40% of the subjects were retired personal, and 15% were sports person. The study conducted by **Sharma V et al** [49] was similar to our study, where they reported mean age with 41.90 ± 13.98 years and 85% of males. **Vaidyar et al** [5] to assess the outcome following rotator cuff repair by mini open approach, from Mangalore Karnataka also reported 67% of the male patients and 33% of the females. Epidemiological studies strongly support a relationship between age and cuff tear prevalence. Chronic rotator cuff defects are more in age from 5th decade onwards and below 40 years it is uncommon. To support the findings of our study a community survey by **Chard et al** [51] on 644 elderly peoples (above age of 70 years) found that rotator cuff was involved in 70% cases of shoulder pain. Similarly studies conducted by **Sugaya et al.,[52] Park et al.,[53] Cole et al.,[54] Burks et al.[55]** also had mean age of 57.7 years, 57 years, 57 years, 56 years respectively which was bit more in comparison to our study.

On functional evaluation we observed that 52.5% subjects were affected on left side. The mean duration of symptoms was 12.75 ± 7.08 months. 37.5% subjects had degenerative type of injury. The mean of Pre OP VAS for pain was 4.6 ± 3.12. With respect to the tear size, 32.5% subjects had small tear size and 30% had large tear. **Sharma v et al** [49] study reported that cuff

tear was on right side which was in contrast to our results. The degenerative rotator cuff tear was noted among 45% of the patients. **Osti et al** [56] results mentioned that 25 % of their patients had small tear size and the rest had medium tear size which measured 1-3 cm. **Gourav et al** [57] mentioned that in his study 23.80% of patients had degenerative tears.

We observed that UCLA score significantly improved over time which was $p < 0.001$. This suggests a steady functional improvement over time. The DASH score significantly decreases over time ($p < 0.001$), indicating reduced disability. This confirms progressive recovery in arm, shoulder, and hand function. **Gartsman et al**. [58] reported highly significant improvements in both general health and function of the shoulder in 55 consecutive patients treated with arthroscopic repair for full-thickness tears of the rotator cuff. They used the SF-36, UCLA, and ASES scores to assess the outcomes, and concluded that SF-36 score could demonstrate the impact of orthopaedic pathology as well as the outcomes of the treatment. **Pearsall et al**. [15] used a case-control study design to report on 52 patients treated with either technique. Although there was a significant improvement in clinical outcome from preoperative (UCLA, SST, Constant and Murley score) to the latest follow-up, the SF-36 was not significantly different postoperatively. **Kim et al, Tauro et al,[59] warmer et al** [60] mentioned that the UCLA scores and ROM findings improved significantly from baseline to the last follow-up. **Vecchini et al** [61] found a non-statistically significant difference between the two groups in term of Constant score (p-value 0.92) and DASH score (p-value 0.43). **Grasso et al [62]** used DASH questionnaires along with other types. The mean DASH scores were 15.4 ± 15.6 points in group 1 and 12.7 ± 10.1 points in group 2; the mean Work-DASH scores were 16.0 ± 22.0 points and 9.6 ± 13.3 points, respectively. He demonstrated no significant difference in outcome scores, respectively UCLA, ASES, Constant and DASH are clinical scores each.

Pair wise comparison if means was done and observed that, all shoulder movement parameters was statistically significant and improvement was seen at 6 months postoperatively ($p < 0.001$ for all) as compared to pre operatively with respect to flexion, extension, abduction, internal and external rotation. **Sharma V et al** [49] findings suggest that mini-open rotator cuff repair of shoulder joint results in marginal improvement after intervention and improve gradually over a period of six months and offer excellent functional outcome and complete pain relief at the end of six months as measured by range of motion, constant score, ULCA score and VAS score without any complications. These findings were consistent with a study by **Vaidyar et al, [5] Levy et al,[63] Baysal et al, [64] and Barness LA et al [65]** despite few methodological differences. **Vaidyar et al** [5] conducted a prospective study to assess the outcome following rotator cuff repair by mini open approach. A study of 30 patients with rotator cuff injuries (13 full-thickness, 17 partial-thickness tears) underwent mini-open repair and were followed for 2 years. The Constant-Murley score improved significantly from 59.5 preoperatively to 91.8 at 2-year follow-up, indicating excellent functional outcomes. The study found no difference in outcomes between partial and full-thickness tears. Despite of lower follow up period the present study showed excellent outcome in all the patients which may be attributed to younger age of the study population in our study. **Baysal et al** [64] prospectively reviewed 84 patients with tears of all sizes, including 17 with large or massive tears, who underwent mini-open repair, and reported a statistically significant improvement in shoulder scores and range of motion. The findings of the present study were consistent with the observations made by **Baysal et al**.[64]

Nazari et al., [66] in their systematic review of meta-analyses, reported that the data comparing the clinical results of Mini-open versus arthroscopic rotator cuff repair methods For the majority of the clinical outcomes that were included, they were able to draw firm conclusions

because they rated the quality of the evidence across all outcomes using the GRADE guidelines, included two more large trials, and provided an analysis of precision by comparing the MCID thresholds with the 95% confidence intervals. But they were unable to make firm conclusions about whether an arthroscopic approach could result in better external rotation range of motion at three and twelve months because the 555 and 462 patients, respectively, in their analysis did not meet the requirements for the calculated optimal information size of 754. As a result, the effects of arthroscopic compared to mini-open rotator cuff repair on function, pain, and range of motion were considered to be too small to be clinically important at 3-, 6-, and 12-month follow-ups.

The structural integrity being high, along with the functional outcome being reported as good for the majority of patients 11.3 years after repair of small- to medium-size rotator cuff lesions [**67**], When it comes to immediate expenditures, mini-open repair of rotator cuff injuries is far less expensive than arthroscopic treatment. The cost of consumables and implants accounts for the majority of the disparity [**68**]. **Shah et al** [69] study revealed that mini-open and arthroscopic rotator cuff repairs are comparable. While longer surgery times were linked to a higher incidence of adhesive capsulitis. **Bond et al**. [70] reported a 2-year follow-up and found that rotator cuff surgery results in good to exceptional pain and function improvement. At 24 months, they did not see any difference in pain or functional outcome between the mini-open, open, and arthroscopic methods for rotator cuff repair.

CONCLUSION

CONCLUSION

This study concludes that mini-open rotator cuff repair yields excellent functional outcomes, gradual improvement over time, and complete pain relief without complications. Given its cost-effectiveness and comparable outcomes, mini-open repair is a viable option compared to

arthroscopic techniques, which require expertise and increased financial burden. Further comparative studies with larger samples and long-term follow-ups are recommended.

SUMMARY

SUMMARY

Shoulder pain is a common complaint among patients presenting with musculoskeletal disorders, with rotator cuff tears being one of the most prevalent problems. Rotator cuff tears may present with a variety of clinical features including debilitating shoulder pain and decreased range of motion. The objective of rotator cuff repair is to alleviate pain and improve function and strength of the affected shoulder. Advances in procedure now allow rotator cuff repair of even largest tears and repair techniques are required to mobilize many of retracted tears. Mini open rotator cuff repair [MORCR] surgery allows for a shorter recovery time and predictably less pain in first few days following procedure than does any open surgery. Therefore we assessed the functional outcome of the shoulder joint in the patients who had undergone mini open rotator cuff repair.

We enrolled 40 patietns with with the diagnosis of rotator cuff tear with strict inclusion criteria. The mean of age was 48.5 ± 14.79 years. 60% subjects were male. 40% subjects were retired personal, 15% were sports person. 52.5% subjects had left side affected. The duration of symptoms was 12.75 ± 7.08 months. 37.5% subjects had degenerative type of injury. The mean of Pre OP VAS was 4.6 ± 3.12. 32.5% subjects had small tear size. The DASH score significantly decreases over time ($p < 0.001$), indicating reduced disability. This confirms progressive recovery in arm, shoulder, and hand function. UCLA score significantly improves over time ($p < 0.001$). all shoulder movement parameters showed statistically significant improvement at 6 months postoperatively.

Based on the findings of this study it may be concluded that, mini-open rotator cuff repair of shoulder joint results in excellent functional outcome among adult patients with rotator cuff tear of shoulder joint especially after six months with gradual improvement with respect to time as assessed by DASH score and ULCA score. It also offers complete pain relief without any complications.

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ANNEXURES

INFORMED CONSENT FOR PARTICIPATION IN DISSERTATION/RESEARCH

I, the undersigned,_____ , S/O D/O W/O _____, aged ____years, ordinarily resident of _____ do hereby state/declare that Dr. A. KHYATHI of Shri. B. M. Patil Medical College Hospital and Research Centre has examined me thoroughly on _____ at _____ (place) and it has been explained to me in my own language that I am suffering from _____ disease (condition) and this disease/condition mimic following diseases. Further Dr. A. KHYATHI informed me that he/she is conducting dissertation/research titled "ASSESSMENT AND FUNCTIONAL OUTCOME OF THE SHOULDER FOLLOWING MINI OPEN ROTATOR CUFF REPAIR." under the guidance of Dr ASHOK NAYAK. requesting my participation in the study. Apart from routine treatment procedure, the pre-operative, operative, post-operative and follow-up observations will be utilized for the study as reference data.

The Doctor has also informed me that during the conduct of this procedure like adverse results may be encountered. Among the above complications, most of them are treatable but are not anticipated; hence there is a chance of aggravation of my condition. In rare circumstances, it may prove fatal despite the anticipated diagnosis and best treatment made available. Further Doctor has informed me that my participation in this study help in the evaluation of the results of the study,

which is a useful reference to the treatment of other similar cases soon, and also I may be benefited in getting relieved of suffering or cure of the disease I am suffering.

The Doctor has also informed me that information given by me, observations made/ photographs/ video graphs taken upon me by the investigator will be kept secret and not assessed by the person other than my legal hirer or me except for academic purposes.

The Doctor did inform me that though my participation is purely voluntary, based on the information given by me, I can ask for any clarification during the course of treatment/study related to diagnosis, the procedure of treatment, result of treatment, or prognosis. I have been instructed that I can withdraw from my participation in this study at any time if I want, or the investigator can terminate me from the study at any time from the study but not the procedure of treatment and follow-up unless I request to be discharged.

After understanding the nature of dissertation or research, diagnosis made, mode of treatment, I the undersigned Shri/Smt _____ under my full conscious state of mind agree to participate in the said research/dissertation.

Signature of the patient:

Signature of Doctor:

Witness: 1.

2.

Date:

Place

PROFORMA

CASE NO. :

NAME :

AGE/SEX :

I P NO :

DATE OF ADMISSION :

DATE OF SURGERY :

DATE OF DISCHARGE :

OCCUPATION :

RESIDENCE :

Presenting complaints with duration :

History of presenting complaints :

Family History :

Personal History :

Past History :

General Physical Examination

Pallor: present/absent

Icterus: present/absent

Clubbing: present/absent

Generalized lymphadenopathy: present/absent

Built: poor/moderate/well

Nourishment: poor/moderate/well

Vitals

PR: RR:

BP: TEMP:

Other Systemic Examination:

Local examination:

SHOULDER

Inspection:

a) Attitude/ deformity

b) Abnormal swelling

- Site

- Size

- Shape

- Extent

c) Skin

Palpation:

a) Local tenderness

b) Bony irregularity

c) Abnormal movement

d) Crepitus

e) Swelling

Movements:	Right	Left
SHOULDER JOINT		
Flexion		
Extension		
Abduction		
Adduction		
Internal rotation		
External rotation		
Active		
Passive		
Resistive		
MUSCLE STRENGTH TESTS –		
Deltoid		
Pectoralis major		
Latissimus dorsi		
Rhomboids		
Trapezius		
Serratus anterior		
SPECIAL TESTS –		
Empty can test		

Infraspinatus and Teres minor

Gerbers test

Belly press test

Drop arm sign

External rotation

SCORING SYSTEMS –

- DASH[15] score
- UCLA[3] score

UCLA SCORE:

PAIN:

- Present all of the time and unbearable, strong medication frequently. 1
- Present all of the time but bearable, strong medication occasionally. 2
- None or little at rest 4
- Present during heavy of particular activities 6
- Occasional and slight. 8
- None. 10

FUNCTION:

- Unable to use limb 1
- Only light activities possible 2
- Able to do light housework or most activities 4

of daily living.

- Most housework, driving possible 6
- Slight restrictions only, able to work above shoulder level 8
- Normal activities. 10

ACTIVE FORWARD FLEXION:

- >150 5
- 120-150 4
- 90-120 3
- 45-90 2
- 30-45 1
- <30 0

SATISFACTION OF THE PATIENT

- Satisfied and better 5
- Not satisfied and worse 0

STRENGTH OF RESTRICTED EXTERNAL ROTATION:

- Grade 5 (normal) 5
- Grade 4 (good) 4
- Grade 3 (fair) 3
- Grade 2 (poor) 2
- Grade 1 (muscle contraction) 1
- Grade 0 (nothing) 0

DASH SCORING SYSTEM

Modified the Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire (m-DASH)

No of question	Question	Difficulty				Unable
		no	mild	moderate	severe	
1.	Arm, shoulder or hand pain	1	2	3	4	5
2.	Arm, shoulder or hand pain when you perform any specific activity	1	2	3	4	5
3.	Stiffness in your arm, shoulder or hand	1	2	3	4	5
4.	Write	1		3		5
5.	Place an object on a shelf above your head	1		3		5
6.	Wash your back	1		3		5
7.	Wash or blow dry your hair	1		3		5
8.	Carry a heavy object	1		3		5
9.	Turn a key	1		3		5
10.	Manage transportation needs (getting from one place to another)	1		3		5

Individualized standardized score is calculated according to equation:

$$\text{Individualized standardized score} = \frac{(\text{Summed value of scale items}^{*} - \text{Minimum score}^{\dagger})}{\text{Score range [Maximum score}^{\ddagger} - \text{Minimum score}^{\dagger}]} \times 100$$

* Sum of scale values

† Number of scale items multiplied by lowest score value (equals 1)

‡ Number of scale items multiplied by highest scale value (1 or 5)

MASTER CHART

sl.no	age (yrs)	gender	dominant affected	occupation	mechanism of injury	VAS for pain	tear size	complications	complications	DASH pre-op
1	40	F	Right	Homemaker	Yes	3	traumatic	9	Small	No	None	9
2	30	F	Left	Laborer	Yes	16	Sports	1	Small	No	None	8
3	64	M	Right	Retired	Yes	18	degenerative	6	Large	No	None	10
4	51	M	Left	Retired	No	19	degenerative	4	Medium	No	None	10
5	56	F	Right	Homemaker	Yes	20	Sports	5	Small	No	None	12
6	49	M	Right	Retired	Yes	6	Sports	5	Medium	No	None	7
7	59	F	Left	Sports person	No	15	traumatic	1	Medium	No	None	10
8	70	F	Right	Retired	No	12	degenerative	0	Medium	No	None	12
9	66	M	Right	Homemaker	Yes	3	traumatic	7	Massive	No	None	9
10	44	M	Left	Office worker	No	13	degenerative	4	Large	Yes	None	10
11	61	F	Right	Retired	Yes	13	traumatic	9	Large	No	None	13
12	61	F	Left	Retired	No	22	traumatic	6	Large	No	None	9
13	26	M	Right	Retired	No	8	Sports	3	Large	No	None	9
14	44	M	Right	Office worker	No	15	traumatic	0	Medium	No	None	6
15	21	F	Left	Laborer	Yes	7	degenerative	8	Large	No	None	10
16	45	M	Left	Sports person	No	24	Sports	7	Small	No	None	7
17	39	M	Right	Laborer	Yes	5	traumatic	4	Medium	No	None	9
18	33	M	Left	Laborer	No	9	degenerative	3	Small	No	None	8
19	22	F	Left	Retired	Yes	20	traumatic	4	Massive	No	None	9
20	52	M	Right	Sports person	Yes	16	traumatic	6	Massive	No	None	9
21	65	M	Right	Retired	Yes	20	degenerative	9	Small	No	None	6
22	52	M	Right	Office worker	Yes	15	degenerative	0	Massive	No	None	6
23	42	F	Right	Laborer	Yes	19	Sports	3	Small	No	None	10
24	70	M	Left	Homemaker	Yes	10	traumatic	10	Small	No	None	9
25	69	F	Right	Laborer	Yes	4	degenerative	1	Large	No	None	8
26	42	M	Left	Retired	No	3	Sports	4	Large	No	None	8
27	26	M	Left	Homemaker	No	5	Sports	8	Large	Yes	None	7
28	70	M	Left	Laborer	Yes	17	traumatic	2	Small	No	None	10
29	44	M	Left	Retired	No	17	traumatic	4	Massive	No	None	8
30	60	M	Right	Homemaker	Yes	23	degenerative	4	Small	No	None	10
31	63	F	Right	Retired	No	5	degenerative	2	Large	No	None	10
32	56	F	Left	Homemaker	Yes	22	Sports	1	Small	No	None	10
33	58	M	Left	Sports person	No	19	Sports	6	Small	No	None	9
34	65	M	Left	Retired	No	5	Sports	8	Medium	No	None	12
35	45	F	Right	Retired	Yes	23	degenerative	10	Medium	No	None	10
36	40	F	Left	Retired	No	7	Sports	9	Massive	No	None	11
37	22	M	Left	Retired	No	3	traumatic	0	Large	No	None	10
38	30	M	Left	Laborer	Yes	3	degenerative	2	Large	No	None	11
39	37	F	Left	Sports person	No	21	degenerative	1	Medium	No	None	8
40	51	M	Right	Sports person	Yes	5	degenerative	8	Small	Yes	None	10

1LA 6 w	LA 3 mn	LA 6 mn	4SH pro	4SH 6 w	SH 3 mn	SH 6 m	r sion pre	on 6 mo	nsion pn	sio n 6	ruction	pi: tion 6 r
14	18	23	84	70	59	50	110	141	32	47	111	144
16	23	28	77	64	45	36	90	113	28	36	106	143
20	25	27	85	62	47	42	125	173	20	38	75	127
18	25	27	60	35	15	5	109	134	35	40	112	161
23	30	31	67	43	31	24	118	162	22	31	112	152
17	23	24	75	58	42	35	102	152	26	45	118	165
21	27	32	68	52	32	19	121	149	35	43	118	149
22	28	30	80	58	42	35	133	158	28	35	75	125
18	23	27	60	38	22	13	124	145	34	39	98	139
21	26	31	85	63	50	42	134	164	26	31	89	134
23	26	27	72	55	40	31	125	163	38	50	103	161
18	24	27	81	57	40	26	109	132	30	48	78	113
17	24	27	63	43	29	21	115	156	39	45	85	125
11	17	27	70	57	38	31	108	157	39	48	75	130
14	20	28	66	43	28	19	139	180	31	50	118	152
14	18	15	60	41	26	12	140	180	21	39	99	144
15	27	31	84	73	64	54	113	147	33	43	102	144
15	26	29	80	67	52	39	103	127	23	33	74	133
14	24	26	78	66	58	51	125	170	27	33	97	152
14	23	25	85	74	56	44	90	113	25	34	108	144
11	21	22	74	59	40	25	128	155	33	42	115	169
14	15	22	80	67	47	35	128	159	23	39	91	132
21	27	29	63	44	33	21	134	180	26	39	115	175
17	24	26	65	42	30	24	107	153	29	36	88	136
16	20	24	77	58	47	33	134	180	40	52	118	170
15	21	26	62	37	28	16	132	164	21	37	118	159
16	17	24	62	47	33	20	102	123	21	28	115	161
19	24	28	68	50	30	19	118	144	30	37	102	150
17	24	29	72	54	35	30	97	130	21	35	72	112
19	19	21	74	63	49	38	98	134	39	47	92	152
15	28	31	80	55	38	23	91	125	22	42	84	144
21	28	29	85	64	47	32	108	134	39	56	78	119
21	24	31	72	59	41	35	96	133	32	39	74	116
21	29	31	72	61	50	41	130	179	29	42	97	128
20	19	29	64	42	23	11	127	167	25	35	117	173
21	26	29	66	44	30	19	95	132	37	45	96	156
18	23	28	79	54	37	29	130	180	20	27	117	147
19	24	26	85	68	51	44	133	166	23	38	89	143
15	25	28	72	54	36	26	111	152	20	28	81	122
21	21	28	64	46	26	16	110	136	37	52	86	121

rotatiotation 6	i rotatiorotation 6 mnths		
47	77	33	51
44	57	14	42
43	61	26	59
30	52	21	59
32	50	26	65
30	59	33	73
34	61	24	63
21	36	31	66
48	58	18	58
45	75	25	47
33	60	28	64
36	57	29	61
50	64	20	36
22	37	19	58
36	60	15	53
42	52	18	33
36	53	35	56
36	47	20	58
37	50	16	33
39	49	18	40
37	66	27	52
43	56	20	45
39	66	15	44
20	49	33	49
22	32	24	51
29	55	30	54
42	59	35	74
37	59	36	69
37	49	30	62
33	43	30	47
35	52	20	44
48	76	25	47
35	57	18	56
37	50	19	39
36	53	32	58
43	63	31	69
27	51	39	70
48	64	22	50
30	49	11	34
35	47	33	58

IEC LETTER

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INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this University met on **Saturday, 18th March, 2023 at 11.30 a.m. in the CAL Laboratory, Dept. of Pharmacology,** scrutinizes the Synopsis/ Research Projects of Post Graduate Student / Under Graduate Student /Faculty members of this University /Ph.D. Student College from ethical clearance point of view. After scrutiny, the following original/ corrected and revised version synopsis of the thesis/ research projects has been accorded ethical clearance.

TITLE: "ASSESSMENT AND FUNCTIONAL EVAUATION OF SHOULDER FOLLOWING MINI OPEN ROTATOR CUFF REPAIR."

NAME OF THE STUDENT/PRINCIPAL INVESTIGATOR: DR.A.KHYATHI

NAME OF THE GUIDE: DR. ASHOK NAYAK, PROFESSOR, DEPT. OF ORTHOPAEDICS

Dr. Santoshkumar Jeevangi
Chairperson
IEC, BLDE (DU),
VIJAYAPURA

Chairman,
Institutional Ethical Committee,
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Vijayapura

Dr. Akram A. Naikwadi
Member Secretary
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VIJAYAPURA

MEMBER SECRETARY
Institutional Ethics Committee
BLDE (Deemed to be University)
Vijayapura-586103, Karnataka

Following documents were placed before Ethical Committee for Scrutinization.

- Copy of Synopsis/Research Projects
- Copy of inform consent form
- Any other relevant document

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