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Arthroscopic assisted versus all arthroscopic rotator cuff repair at mid-term follow up.

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ABSTRACT

Background

Among the most common causes of the shoulder pain and disability are the rotator cuff tears. The repair of rotator cuff has developed from traditional open repair to mini open repair to an all arthroscopic repair technique. The size of the tear appears to be a major determinant in the functional outcome. We noted large tears did not do better compared to small and medium tears. Overall VAS score as well as UCLA rating was better in patients with small and medium sized tears than large tears. UCLA score for motion and strength in the mini open group decreased at 3 months follow up from its pre operative values but improved significantly at final follow up. However, this trend was not seen in arthroscopic group in which there was a steady improvement in all the parameters. The UCLA score between the mini open group and all arthroscopic group showed a significant difference both at 3 months and at final follow up($p<0.05$) with higher scores in all arthroscopic groups. The arthroscopic repair is safe.

Keywords: mini-open repair, arthroscopic repair, acromial spur, traumatic tears, degenerative tears, massive tears

Introduction:

Rotator cuff tears are amongst the common pathologies involving shoulder joint (1). Other than traumatic causes, the symptoms are usually subtle and manifest by loss of power usually in simple everyday tasks when the arm is rotated laterally such as combing, applying hair cream etc (2). The natural history of rotator cuff disease was originally proposed by Neer (11) who described rotator cuff disease in three stages. First stage occurring in individuals younger than 25 years of age, involving haemorrhage and oedema of tendon. Second stage occurring in the age group of 25-40 years with fibroses and tendinitis of the cuff and third stage is the last stage culminating in tears of partial or full thickness involving patients over the age of 40. Rotator cuff repair can be done using traditional open repair, mini-open repair or all arthroscopic technique. Codman (9) was first to describe operative repair of the rotator cuff in 1911 and reported that twenty of twenty one patients repaired successfully of full thickness tears.

Material and methods:

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The present study was conducted from March 2013 to January 2019.It was conducted in Bone and Joint Hospital, Barzulla, Government Medical College Srinagar. This prospective study consists of a total of 100 cases, with 50 cases that went through Mini-Open Rotator cuff repair and 50 cases with arthroscopic repair and 3 years of mean follow-up. Patients between 18 to 70 years of age, full-thickness tears and of both sexes were included. Exclusion criteria included associated fractures around the shoulder, glenohumeral joint degenerative arthritis, associated labral pathologies, acromioclavicular joint symptomatic arthritis, medical co-morbidities, e.g. diabetes, neurological disorder, prior surgery on same shoulder, biceps degeneration and pathology, massive tears, partial-thickness tears.

A high clinical suspicion was employed in patients with history of direct trauma to shoulder. We used a triad of clinical signs of physical examination to suspect a rotator cuff of full thickness tear which included:

1. Supraspinatus weakness elicited by Jobe's empty can test and arm drop test.
2. Impingement sign elicited by Neer's and Hawkin-Kennedy tests, painful arc sign.
3. Infraspinatus weakness on external rotation stress test.

Combination of 2 of the above in a patient over 60 years and all three in patients below 60 yrs was employed to short list patients for further evaluation for rotator cuff tear. Radiographic examination included true anteroposterior views, a scapular lateral view, an axillary lateral view and an outlet view of the involved shoulder. The type of acromion, presence of acromial spur, associated acromioclavicular joint arthritis, glenohumeral arthritis and any impinging osteophytes were noted. MRI evaluation was done. The acromion was classified. Any acromial spur was noted and thickness of acromion was measured.

All pre and post-operative physical and clinical evaluation was carried out and included the data from the following: 1) Demographics; 2) UCLA rating scale; 3) Visual analogue scale (Pain assessment; 3) Range of motion; 4) Size of tears; 5) Traumatic versus atraumatic tears. UCLA rating score, range of motion and VAS score was noted at 3 months post operation and at final follow up. We have evolved rotator cuff repair technique from a "mini open" procedure to all arthroscopic procedure .The initial cases of all arthroscopic procedure were not included in the study group to avoid bias due to technical errors.

Surgical technique:

Mini-open:

Patients were put in a lateral decubitus position and put under general anaesthesia. Rotator cuff repair was executed in a stepwise fashion. An ideal diagnostic arthroscopy was done via the posterior portal (3,4). The arthroscope was directed into subacromial space from the posterior portal. An arthroscopic subacromial bursectomy and an anteroinferior acromioplasty was then performed (3,5). The decision to do acromioplasty depended on the intraoperative evidence of extrinsic compression either due to the shape of the acromion, its thickness, presence of an acromial spur with a thickened coracoacromial ligament, extent of tear and its reparability. The decision to resect the coracoacromial ligament was also done intraoperatively after visualization of rotator cuff and determining its size and reparability (3). At this point mini-open approach was initiated. The arm was placed

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by the patient's side and a small transverse incision (about 3-4 cm) incorporating the lateral portal along the Langers lines was made. Tears were visualized and the arm was rotated to allow different positions of the torn cuff visible through the deltoid split (3,6). All tears were classified according to Cofield's method of full-thickness tears with <1 cm as small, 1-3 cm as medium and 3-5 cm as large tears.

Measurement was done at the widest diameter (5). For small to medium tears with a strong tendon and good mobilization, simple sutures were placed at the tendon edges (6 mm apart), whereas for large tears with a weakened
tendon, tendon was stitched with a Mason-Allen stitch and then mobilised. The length of detachment determined the number of sutures (3,6-8). Based on the size and pattern of tear, bone tendon fixation was achieved by medial suture anchor placement and a lateral transosseous suture placement individually or in combination. When performing a single row repair, the anchor was placed at or near the greater tuberosity of lateral edge. To attain the smooth upper surface of the repaired cuff, simple sutures with knots buried again requiring a side-to-side component of the repair (3,6,8).

Arthroscopic:

The initial glenohumeral joint and subacromial evaluation
and subacromial decompression was done in the same manner as in the mini open technique. After sizing the tear, any adherent tendons in the region of the superficial bursa, glenoid labrum, coracoid base were released and mobilized. Based on
the magnitude and anatomy of tear, bone tendon fixation was achieved by medial suture anchor placement and a lateral row of suture anchor placement individually or in combination. When performing a single row repair the anchor was placed at or
near the greater tuberosity of the lateral edge. When using double row technique, the medial row suture anchor was placed just off the articular margin of the footprint. Depending upon the tear size, single row or double row suture technique was used. A single-row repair was performed for less than 3 cm tears in length, while a double-row repair was performed for tears greater than 3 cm in length in the form of trans-osseous equivalent repair using push-lock anchors. It is comparable to the double row repair technique, apart from the lateral row fixation that provides rotator cuff compression to the tuberosity involving the medial sutures. Following completion, a range of
motion was applied to the arm ensuring no impingement of cuff or gapping of anterior repair on the acromion.
Patients were examined at 1 week after surgery, then 2-weekly for 3 months, then once a month for1 year and then 6-monthly for 3 years.
For both the procedures UCLA scoring was done preoperatively and at 3 months and 3 years with documentation of a VAS score as well. Range of motion was also documented. The specific rehabilitation used in both the groups was same involving sling immobilisation and passive ROM for 6 weeks initially, between 6 and 12
weeks progressing to active motion, at 12 weeks beginning resistive exercises, and returning to full activity at 6 months.

Statistical analysis:

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All variables and patient demographics were subjected to descriptive analysis. Paired t-tests were used for comparing UCLA scores, range of motion and VAS pain scales. Dependent, independent variables and their effect were statistically analysed by ANOVA. Correlation analysis between between independent variables as well as outcome scores was done. Clinically significant was considered less than or equal to 0.05.

Results:

100 patients met the study criteria with 50 patients in each of the subgroups. There were 38 males and 62 females. MRI diagnosed patients had a full thickness rotator cuff tear. Overall, the average age of 100 patients was 54 yrs (range 17-70 yrs) at the time of surgery. The average duration of symptoms was 4.96 months before surgery for the traumatic tears and 13.05 months for the degenerative tears. The rotator cuff size was 3.38cm (range 1-5cm) on an average. In two groups, the tear size was insignificant. Acromioplasty was done in 64 patients with 32 in each group. The patient characteristics of two groups were compared and are summarized in Table 1.

Overall, significant improvement was noted at the final follow up from preoperative UCLA and pain score. Range of motion from preoperative status also showed a significant improvement. UCLA rating in 90% of patients was excellent or good and 94% patients were satisfied at final follow up. This is depicted in Table 3. UCLA scores for motion and strength in the mini open group decreased at 3 months follow up from its pre operative values but improved significantly at final follow. However, this trend was not seen in arthroscopic group in which there was a steady improvement in all the parameters. Two groups were analysed separately to compare the results of mini open and arthroscopic rotator cuff repair techniques and depicted in Table 2.

The tear size seems to be a key factor in the functional outcome. The larger tears performed better than small and medium tears. Overall, VAS (Table 4) score as well as UCLA rating was better in patients with small and medium sized tears than large tears. Clinical outcome between degenerative and traumatic tears of the same size in either of the groups were statistically insignificant. Patient satisfaction did not correlate with functional outcome with 94% patients satisfied overall. Tears occurring from a direct trauma in this study were mostly large sized tears. Also degenerative tears with pre operative follow up time of 12.8 to 13.3 months on an average were mostly medium sized tears.

TABLE 1:

Pre operative analysis of groups

	Mini open	arthroscopic
No. of patients	50	50
Age(in years)	56.52(range 17-70)	51.48(range 30-65)
Gender (male/female)	20/30	18/32
Traumatic etiology	30	26
Dominant side involvement	34	42
Acromial spur	30	20

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Acromial thickness(in mm)	7.7(range 5.8-11.8)	7.62(range 5.1-11.5)
Acromion type(Bigliani) Type I Type II Type III	 24 16 10	 18 22 10
Tear size small medium large	 16 16 18	 14 20 16
Time from injury/symptoms to surgery	3.16 mo (traumatic) 12.8mo(atraumatic)	6.76(traumatic) 13.3(atraumatic)
Pattern of tear Crescent L shaped Reverse L shaped U shaped Trapezoid	 30 12 2 4 2	 34 10 0 6 0

TABLE 2

Parameter	Mini-open			Arthroscopy		
UCLA SCORE	Preop	3mnth	Final f/u	Preop	3mnth	Final f/u
Pain	2.52	7.68	8.72	3.36	8.64	9.04
Function	2.72	3.12	8.56	2.52	4.08	8.96
Motion	2.62	2.44	4.44	2.16	2.76	4.76
Strength	3.2	3.12	4.4	3.16	3.28	4.48
Satisfaction	0	3.2	4.6	0	3	4.8
Total score	11.06	19.56	30.72	11.2	21.76	32.04
Frward flexion	85.8	94.32	153.6	71.4	97.2	158.8
Abduction	79	83.92	156	61.8	91.2	160.45
Ext.rotation	26.64	23.2	42.08	28.8	30.2	45.2
VAS score	7.76	1.84	1.28	7.28	1.2	0.72

Table 3
UCLA score comparison

Parameter	Mini open No.of patients	Arthroscopic No. of patients

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Excellent	28	32
Good	16	14
Fair	3	2
Poor	3	2
Total	50	50

TABLE 4

Visual Analog Scale for assessment and comparison of pain:

Duration	(VAS SCORE)mini open	Arthroscopy
Preoperative	7.76	7.28
2nd post operative day	4.48	4.45
1 week	3.04	3.52
3 week	3.44	2.96
6 week	2.56	1.84
3 month	1.84	1.2
Final f/u	1.28	0.72

Discussion:

Rotator cuff repair has revealed to give an expected pain relief and functional improvement. As mentioned earlier, Codman (9) was the first to describe rotator cuff repair by operative methods in 1911. He noted a remarkable improvement of twenty out of the twenty one patients after full thickness repair of rotator cuff tear. A great variety of operative approaches, methods of repair and decompression were described in the following years. The complexity of these techniques varied from simple, direct sutures to whole muscle advancement of the supraspinatus, freeze dried cadaveric grafts, and combined transfer of the subscapularis and the teres minor(10). In any surgical approach, the goal of surgical repair as described by Neer (11), is careful deltoid origin repair and preservation; appropriate subacromial space decompression, free procurement of mobile muscle tendon units by surgical release, as necessary; fixation of tendon to greater tuberosity; and prevention of post operative adhesions and successive stiffness along with no disruption of repair by a carefully monitored rehabilitation program. When used for non massive tears(<5cm), open rotator cuff repair rendered 85% to 100% results in pain relief(12,13) and 70% to 95% in functional improvement(13,14). However, morbidity from this procedure has included rigorous early post operative pain, arthrofibrosis and weakness and /or detachment of deltoid (12,13,14).

Over the last few decades, medicine and orthopaedics particularly, has gained a thorough understanding of the development of surgical techniques that are less invasive and render more appropriate bone fixation systems (15,16,17). New surgical methods were developed in arthroscopic technology and techniques, to integrate the advantages of reduced post-operative pain

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and swift functional improvement linked to other arthroscopic procedures for rotator cuff pathology repair with known effectiveness of open technique. Therefore, mini-open technique was developed (18). Mini-open repairs had the potential convenience of smaller skin incision, less deltoid morbidity, less soft tissue dissection, less post-operative pain, more rapid rehabilitation and results that are similar to that of open technique (19-24).

Levy.etal. (20) in their preliminary study described the procedure of mini-open technique. Following in 1994, Paulos and Kody (23) further described it in a long term follow up study.They performed an arthroscopic decompression followed by open rotator cuff repair. They administered it through a lateral deltoid split on the patient in lateral decubitus position. The rotator cuff repair was performed in the same manner as the open repair but through a smaller incision. All the releases were performed open following which they secured a bone tendon fixation using a combination of suture anchors and transosseous sutures. They found that 16 of their 18 patients with mean of 48 months postoperatively rendered good or excellent results. Several subsequent studies showed comparable rate of good and excellent results.

Recently, the advancement and innovation of technology in general arthroscopic instruments and appliances of rotator cuff repair, a more emphasis has been towards the all-arthroscopic repair of rotator cuff tears. Theoretically, the benefits of such a technique take account of less surgical insult to the deltoid, less postoperative stiffness and pain. These properties may result in a faster restoration to functionality and work, as well as patient satisfaction. However, switching to all-arthroscopic repairs involves reluctance due to concerns of functional deterioration, integrity of repair and the complexity in achieving expertise of this technique (25,26).

Independent studies examining the cuff integrity and clinical outcomes in long-term rotator cuff injuries repaired arthroscopically found comparable to mini-open and open procedures in terms of success rate (25). The observations suggest that there was insignificant difference concerning the post operative pain between the mini open and all arthroscopic groups over the study period. Though the pain scores were better in all arthroscopic group, the VAS score in mini open group were lower during first two weeks. The reason for this can be numerous. Periglenoidal release may have been performed more extensively in the mini open group because bleeding is less of an issue than in arthroscopic repair where a clear visibility of the repair is vital (27). A more broad release, on the other hand, is advantageous for the muscle tendon unit in reducing tension, that may alleviate postoperative pain (27). Another issue during ASC (Arthroscopic Repair) is the soft tissues swelling which can impede healing in very short term, also bursa is yet another issue. To achieve good visualisation, slightly more bursa ought to be removed during ASC. Bursa comprises of cells that could aid in healing and has high vascularity (28) but in bursitis patients (29–31), increased levels of cytokines as a result of inflammation and pain mediators can be found and therefore this tissue removal can prove beneficial.

In our study UCLA score and range of motion was used to compare outcomes between the two groups. We found that at 3 months there was significant improvement in UCLA score in both mini open (11.06 to 19.56) as well as all arthroscopic groups (11.2 to 21.76) with a higher score in all arthroscopic group. This trend was similarly seen at final follow up with final UCLA score of 30.72 in mini

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open group and 32.04 in all arthroscopic group. The score showed significant difference between the two groups both at 3 months and at final follow up ($p<0.05$) with higher scores in all arthroscopic group.

The range of motion also showed significant difference of the two groups with improved motion in all arthroscopic group. Several studies had compared mini-open and arthroscopic surgery, and yielded statistically insignificant difference measurements (32-38). A few studies also report thatASC technique contribute to a better results. Another study comparing open and arthroscopic rotator cuff repair clinical results by Buess et al. (39) confirmed that arthroscopic cuff repair provided more effective results than open repair. The open group though mixed conventional and mini-open technique (12 and 18 patients, respectively). Pain scores (VAS) in the ASC were highly improved than MO group and with similar simple shoulder test (SST) and patient satisfaction were reported. The later study's set back included its heterogeneous pathology, retrospective nature, and reliance solely on a questionnaire.

A long-term retrospective comparison of ASC and MO techniques published by Severud et al. (40,41) indicated that in the ASC group, motion was slightly better with no shoulder stiffness and were statistically significant at 6 and 12 weeks (not significant at final follow-up). Also comparing results to the MO group indicated 14% shoulder stiffness. In another study, Bishop et al. (42) compared 24 open and 8 mini-open surgery (heterogeneous cohort) to an arthroscopic cohort. They recommended an open technique for large tears for lesser rate of re-tears. Walton and Murrel (43) studied 200 true open and arthroscopic cuff repair each. They recommended arthroscopic repair to open considering the integrity of cuff, operative time, and postoperative recovery. Colegate-Stone et al. (44) in another study repaired tears arthroscopically that were less than 3 cm in diameter, while MO procedure was used for tears larger than 3 cm. As a result, ASC group after 24 months outperformed the control group in terms of Constant-Murley, Oxford scores, and disabilities of the arm, shoulder, and hand (DASH). Another study by Millar et al. (45) discovered ASES scores that were 20% higher and in ultrasound studies there were fewer retears in the ASC groups compared to a MO double-row anchor fixation (45). By two years of post-surgery, almost 48% of patients () lost to follow-up in retrospective cohort design, and multiple sonographers performing the imaging were the limitations of that study.

Conclusion:

In our study, four patients with large sized tears developed frozen shoulder post operatively in the mini open group compared two patients in arthroscopic group. Stiffness persisted at 1 year but resolved at final follow up. No patient needed any surgical intervention. One patient in arthroscopic group in whom trans-osseous equivalent repair was done, one metallic suture anchor backed out in the first week after surgery and the patient was re-operated after 1 week. However, the final UCLA score was 35 and the patient was satisfied. Adhesive capsulitis is one of the most common complications. All-arthroscopy outperforms MO repair in terms of postoperative rehabilitation due to least injury to the soft tissue. Despite the preservation of the deltoid origin, the MO approach still necessitates a deltoid fibre splitting leading to its extension in the subdeltoid bursa exposing the surgery area, resulting in scarring and stiffness of subacromia. In conclusion, the arthroscopic

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repair is safe, has less post-operative pain, is cosmetically more acceptable with quicker rehabilitation and has excellent functional results.

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