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## Functional outcome and repair integrity of arthroscopic management of rotator cuff tears by single row technique- a short term assessment

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### Abstract

**Purpose:** To evaluate the results of arthroscopic rotator cuff repair by single row technique using UCLA shoulder scoring, visual analogue scale for pain and Shoulder strength index.

**Method:** 30 patients with symptomatic full-thickness large and massive rotator cuff tear of more than 50% thickness underwent arthroscopic repair with single row technique. Results were evaluated by use of the UCLA shoulder scoring, visual analogue scale for pain, the Shoulder Strength Index (SSI), and range of motion for functional outcome.

**Results:** Out of 30 patients (15 male and 15 female with mean age of 44.27 years, range 51- 60 years) with 16 complete tear and 14 partial tear. Mean operative time was 51.83 minute. The mean follow-up was 18.83 months. UCLA score improved from  $17.93 \pm 2.43$  at the time of presentation to  $30.6 \pm 4.41$  at 6 months with p value  $<.0001$ . The VAS improved from a mean of  $5.6 \pm 1.4$  to  $2.4 \pm 2.7$  (p value  $<.0001$ ). Shoulder strength index and range of motion significantly improved at the follow up (p value  $<.0001$ ). Results were satisfactory in 87.1% (59.7% excellent and 27.4% good), with 12.9% unsatisfactory.

**Conclusion:** Arthroscopic management of rotator cuff tear by single row technique can produce satisfactory results with significant relief of pain, function, range of motion and overall satisfaction of the patient.

**Keywords:** Rotator cuff tears, full thickness, partial tear, subacromial decompression, single row technique, shoulder arthroscopy.

### 1. Introduction

The rotator cuff, formed posteriorly by the tendons of the supraspinatus, infraspinatus and teres minor and, anteriorly by the tendon of the subscapularis, has an important contribution in the stability as well as mobility of the shoulder joints. Any pathology of this structure is one of the main causes of disability in the shoulder joints<sup>[1, 2]</sup>. Satisfactory results of the conservative treatment vary in literature between 40 and 82%, whereas factors such as: age, co morbidities, activity levels and degree of shoulder dysfunction can interfere in conservative trials. With the increase of functional demand such as sports, work and/or daily activities, etc., in some patients the conservative treatment might not be successful. This situation has occurred more frequently due to the increase in life expectancy and quality<sup>[3, 4]</sup>.

Optimizing tendon healing is the primary goal of rotator cuff repair surgery. The healing of tendon has been shown to improve active motion, strength, and patient self-assessed function after rotator cuff repair<sup>[5, 6]</sup>. Whereas small and medium sized rotator cuff tears or partial rotator cuff tears are successfully managed with any surgical repair or Sub-acromial decompression in the vast majority of cases, the optimal management of large and massive rotator cuff tears has been controversial and continues to evolve. Tendon retraction, adhesions, and poor tissue quality along with poor quality of bone common in these tears make repair one of the most technically complex procedures in the shoulder.

Arthroscopic techniques and instrumentations are improving gradually and rapidly, and arthroscopic rotator cuff repair has gained popularity. Double anchors technique is reported to reestablish the normal rotator cuff footprint and increase the contact area for healing<sup>[7, 8]</sup>. so

anatomical and biomechanical are better than with the single anchor technique [9, 10, 11, 12].

The arthroscopic technique demonstrates similar results to open surgery, however associated with extra advantages such as: preservation of the deltoid, minimal surgical scar, possibility of articular diagnosis, lower surgical morbidity, allows early and easier rehabilitation, and decreased postoperative pain [13, 14, 15, 16].

The aim of this study was to evaluate the functional outcome and repair integrity of the arthroscopic treatment of the rotator cuff tears performed in our institute through single row (double anchor) technique.

## 2. Materials and Methods

**2.1. Patient Selection:** Patients were recruited among those who came directly or referred by primary care doctors because of symptoms of rotator cuff tears and were enrolled in the study after detailed clinical history and examination and by radiological evaluation through X-ray, USG and MRI of affected shoulder from May 2015 to May 2018.

### 2.1.1. Inclusion criteria:

All adult patient with complete rotator cuff tear:

- Young patients (18- 60 years).
- Primary case of complete rotator cuff tears.
- Athletic patient with rotator cuff tear tears.
- Pain refractory to at least 6 weeks of physiotherapy.

### 2.1.2. Exclusion criteria

- Localized or generalized infection.

- Gleno-humeral osteoarthritis,
- Ipsilateral shoulder pathology,
- Previous surgery on the affected shoulder,
- Contra lateral shoulder pathology,
- Fatty degeneration grade 4 of Fuchs,
- The active use of steroids, and
- Inability to complete questionnaires or to complete the rehabilitation treatment.

## 2.2. Clinical Evaluation

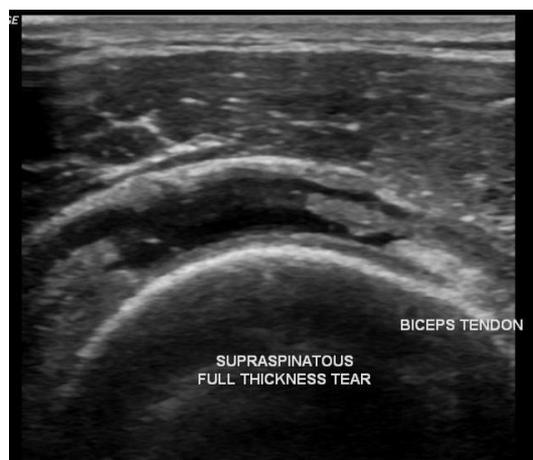
Detailed clinical evaluation was performed on all patients preoperatively with thorough history, clinical examination and specific tests and at least 6 months postoperatively. Data were collected to allow a determination of the University of California, Los Angeles (UCLA) score. The range of motion was evaluated with a goniometer in flexion, abduction, internal rotation, and external rotation. Muscle strength was tested in flexion, abduction, internal rotation, and external rotation with appropriate tests for specific muscles. Instead of using the absolute value of the muscle strength, we used relative muscle strength of the affected shoulder compared with the muscle strength of the contralateral shoulder. Because normal muscle strength for each patient is totally different from that of others, comparison of the absolute values is meaningless.

## 2.3. Imaging.

All patients received a standard preoperative radiological evaluation with X-ray, USG, and MRI of the affected shoulder as per UCLA protocol (Figure 1, 2 & 3)



**Fig 1:** True AP of shoulder joint view showing decreased acromion-humeral interval with degeneration.



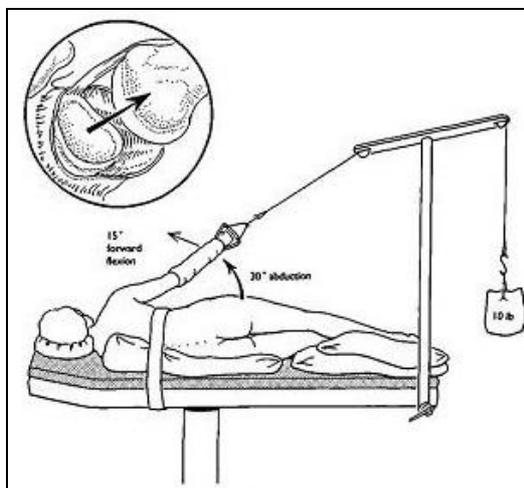
**Fig 2:** USG showing full thickness supraspinatus tear



**Fig 3:** MRI showing full thickness supraspinatus tears.

**2.4. Surgical technique**

Surgery was performed under general anesthesia with patient in lateral with 30 degree of arm abduction and 15-30 degree of forward flexion with 10 lb of traction (Figure 4).



**Fig 4:** Lateral decubitus position for shoulder arthroscopy

As per the standard shoulder arthroscopic technique for rotator cuff repair and ASD four portals were usually made. Posterior and lateral were the viewing portals and anterior portal was used as working portal. However posterior and lateral were also used as working portal. The bony landmarks were palpated and outlined with a sterile marking pen. These include the acromial borders, the coracoid process and the distal clavicle (Figure 5).



**Fig 5:** Showing marking for portal placement for shoulder arthroscopy

1. Posterior portal, 2. Posterolateral portal, 3. Lateral portal,
4. Anterolateral porta, 5. Anterior portal, CL.-Clavicle, ACR- Acromion

Arthroscopic portals were oriented along the skin lines to give the best cosmetic results. The standard posterior portal was oriented vertically in the soft spot of the shoulder approximately 2cm inferior and 2cm medial to the posterolateral corner of the acromion. This portal was used for arthroscopic inspection of the glenohumeral joint. The posterolateral portal was also used for RCT repair and subacromial decompression. It was placed 1 cm medial and 1 cm inferior to the posterolateral corner of the acromion. From the posterolateral portal we could enter the subacromial space directly. The anterior portal, was also oriented vertically, was created just lateral to the coracoid tip and was used for the passage of instruments, such as resectors into the glenohumeral joint to allow debridement of the labrum or rotator cuff. An anterolateral portal was placed approximately 2 cm lateral to the anterolateral corner of the acromion. It was oriented horizontally along the skin creases approximately parallel to the lateral acromial border. This portal allowed passage of the resectors, electrocautery, and burr into the subacromial space during the arthroscopic acromioplasty portion of the procedure.

First initial diagnostic arthroscopy was performed for assessment of tear and shoulder joint. Debridement of tendon margin was performed and tendon mobility was evaluated with the use of grasping clamp. The greater tuberosity; the footprint of supraspinatus tendon or lesser tuberosity; the footprint of subscapularis tendon was abraded with a burr to create a bleeding bone surface over bone bed.

In cases of partial tear subacromial decompression with or without acromioplasty was performed (**Figure No 6**).



**Fig 6:** Showing Inside out technique for anterior portal placement.

In cases of complete tear single row repair technique was used. Repair was performed by use of suture passing instrument (smith and Nephew). An arthroscopic knot was tied, reattaching the tendon to the bone (Figure No 7).



**Fig No- 7 (A)** Arthroscopic view showing a rotator cuff tear involving the supraspinatus. **(B)** The arthroscopic view from the lateral portal shows complete repair of a rotator cuff tear using the conventional single Row Technique

**3. Statistical Analysis**

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected then non parametric test was used. Quantitative variables were compared using unpaired t-test/Mann-Whitney Test (when the data sets were not normally distributed) between the two groups and ANOVA/ Kruskal Wallis test was used for comparison between more than two groups. For comparison across follow up within group, paired T test/ Wilcoxon rank sum test was used. A p value of <0.05 was considered statistically significant. The data analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

**4. Results**

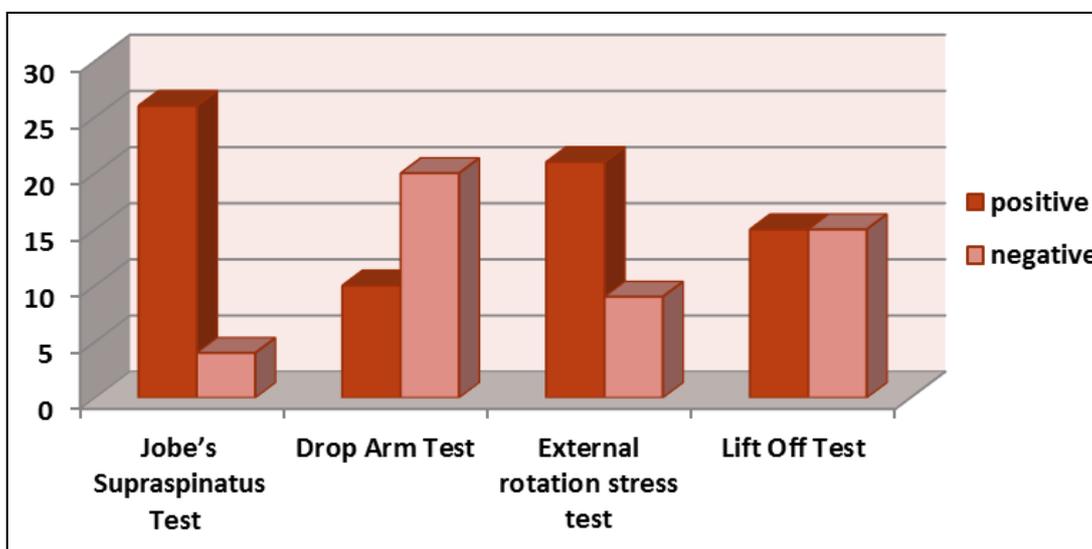
This study was conducted on 30 patients with full thickness rotator cuff tear or symptomatic partial thickness tear of more than 50% thickness, with equal distribution in male and female. Mean age in our study was 44.27 and most of the patients were in 51-60 years age group. Dominant side was involved in 22 while non dominant shoulder was affected in 8 patients. 19 patients suffered from RCT due to trauma while it

was degenerative in 11. Complete RCT was found in 16 and partial RCT in 14 out of 30 patients [Table 1].

**Table 1:** General characteristics of patients (n=30)

	Characteristics	Frequency	Percentage
Age in years	<30	5	16.67%
	31-40	7	23.33%
	41-50	4	13.33%
	51-60	14	46.67%
Gender	Male	15	50.00%
	Female	15	50.00%
Affected side	Dominant	22	73.33%
	Non Dominant	8	26.67%
Etiology of Rotator Cuff Tear	Degeneration	11	36.67%
	Trauma	19	63.33%
Type of Rotator Cuff Tear	Complete Tear	16	53.33%
	Partial Tear	14	46.67%

Jobe’s Supraspinatus Test was positive in 26 patients, Drop Arm Test was positive in 10 patients, external rotation stress test was positive in only nine patients Lift off Test was positive in 15 patients [Graph 1].

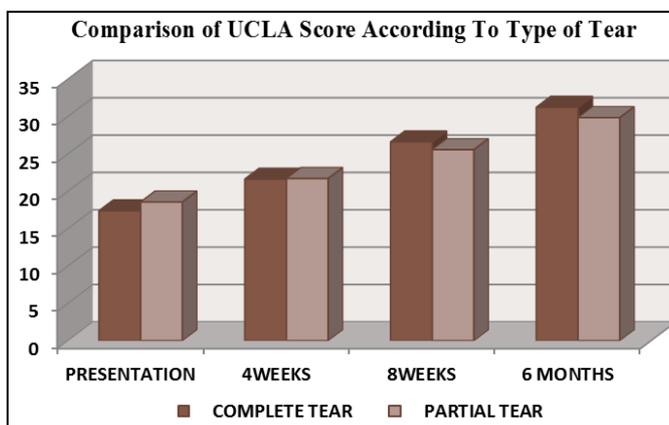


**Graph 1-** Showing evaluation of specific tests of shoulder

Mean operative time was 51.83 minute. In first 15 cases the mean operative time was 61 minutes while in the last 15 cases it was 42.6 minutes. UCLA score improved from 17.93 ± 2.43 at the time of presentation to 30.6 ± 4.41 at 6 months with p value <.0001. 8 patients (27%) had excellent results, 18 patients (60%) had good results, and 3 patients (10%) had fair results and one patient (3%) had poor result [Table 2].

**Table 2:** showing evaluation of UCLA Score of the patient in our study

	Sample size	Mean ± SD	Median	P value
UCLA Score at Presentation	30	17.93 ± 2.43	18	
UCLA score at 4weeks	30	21.67 ± 2.7	22	<.0001
UCLA Score At 8weeks	30	26.13 ± 3.52	27	<.0001
UCLA Score At 6 Months	30	30.6 ± 4.41	32	<.0001



**Graph 2-** Showing UCLA scoring based on type of tear  
87% patients had no complications.

Patient with complete tear, operated by single anchor repair had shown better results at the final follow up, as compared to subacromial decompression done in partial tear patient [Graph 2].

Shoulder Strength Index was calculated and found to be improved significantly (p value<0.05) [Table 3].

**Strength measurements: Shoulder Strength Index (SSI) [Table 3]**

**Table 3:** Measurement of Shoulder Strength Index (SSI):

Variable	Pre-op (Median ± SD)	Post-op (Median ± SD)	P value
Flexion SSI	0.55 ± 0.05	0.73 ± 0.03	<0.001
Abduction SSI	0.56 ± 0.06	0.71 ± 0.03	<0.001
Internal rotation SSI	0.52 ± 0.03	0.74 ± 0.03	<0.001
External rotation SSI	0.56 ± 0.03	0.79 ± 0.02	<0.001

Range of motion and patient functional assessment also improved significantly in all range of motion (p value<0.05) [Table 4].

**Range of motion and patient functional assessment [Table 4]**

**Table 4:** Range of motion and patient functional assessment

Rotator cuff repair	Intact	Partial-thickness defect	Full-thickness defect	P value
External rotation, deg	62.3 ± 3.1	53.1 ± 2.9	44.2 ± 3.3	<0.001
Internal rotation, deg	57.1 ± 2.2	52.6 ± 3.5	38.5 ± 4.1	<0.001
Flexion, deg	153.3 ± 5.2	142.1 ± 4.7	116.8 ± 7.2	<0.001
Abduction, deg	138.4 ± 4.7	123.5 ± 5.2	103.3 ± 5.2	<0.001

There was only one case in which there was anchor pull out in 2<sup>nd</sup> week postoperative period during rehabilitation. Three patients had not significant improvement on UCLA shoulder scoring system at six month of postoperative period. MRI was done and re-tear was confirmed in those three patients for which they were re-operated.

**5. Discussion**

Among various management options arthroscopic management of rotator cuff tear (RCT) is currently the preferred method [17]. however arthroscopic repair of full thickness RCT poses technical challenges. Previous studies have shown a positive correlation between the postoperative clinical outcome and anatomical healing.<sup>18</sup> our study was conducted to assess the short term outcome of arthroscopic management of rotator cuff tear.

In our study, majority (46%) of the patient were between the age group of 51-60 years. Milgrom *et al.* [19]. studied the integrity of the rotator cuff in 90 asymptomatic adults between the ages of 30 and 99 years using ultrasound. He showed that the prevalence of partial- or full-thickness tears increased markedly after 50 years of age. Our study also had majority of patient of age greater than 50. Boileau *et al.* [20] reported that the age was clearly a factor influencing tendon healing [60]. They found that the patients who had a healed tendon were, on the average, ten years younger than those in whom the tendon did not heal. They concluded that the chance of tendon healing decreased to 43% after 65 years of age. However, they stated that the absence of tendon healing (or only partial healing) did not necessarily compromise pain relief and patient satisfaction.

There was no gender predominance in our study. Razmjou *et al.* [21]. found women reported more repetitive injuries and men had a higher rate of falls. Harryman *et al.* [22]. evaluated patient satisfaction, functional outcome, and ultrasonographic cuff integrity after 105 rotator cuff repairs and found no significant correlation of patient sex with the outcomes. In our study also there was no difference in functional outcome in

correlation to patient sex.

In our study, dominant extremity was more commonly involved. Milgrom *et al.* Showed hand dominance, occupation and leisure activities appear to have a limited influence on the timing of onset and rate of progression of mature atraumatic tendon degeneration.

Trauma (63.33%) was most common cause of RCT, followed by degeneration (36.66%) in our study while it is mostly degenerative as compared to other studies. Reason for this difference possibly could be due to inclusion of only the age group of 18-60 years [Table no 5].

**Table 5:** Showing comparison of etiology of rotator cuff tear with other studies

Study (year of publication)	Trauma No of patients (%)	Degenerative No of patients (%)
Our study (2017)	19(63.33%)	11(36.66%)
Cho <i>et al.</i> [18] (2009)	55(32.5)	114(67.5)
Voigt <i>et al.</i> [23] (2010)	3(6%)	47(92%)
Neyton <i>et al.</i> [24] (2013)	28/107(26.2)	79/107(73.8)
Choi <i>et al.</i> [25] (2014)	46/147(31.3)	101/147(68.7)

In our study, Jobe’s supraspinatus test was positive in 86.66% of cases. Fodor *et al.* [26] indicated supraspinatus involvement with a specificity of 90% with Jobe’s supraspinatus test. Walton *et al.* [27] showed in his study that Jobe’s test was relatively sensitive (86%), but not very specific (58%) for either a full or a partial thickness RCT.

In our study, lift off test was positive in half of the patients. Gerber and Krushell<sup>27</sup> have described and validated the lift-off test for isolated subscapularis tears.

External rotation stress test was positive in 30% of cases in our study. Sgroi *et al.* [28] did the clinical assessment of the presence of a rotator cuff tear by testing Jobe’s Supraspinatus test and external rotation stress test. He found a sensitivity of 91% and a specificity of 75%. The predictive value of a positive test was 94%; the predictive value of a negative test was 66%. The sensitivity for distinguishing between a large or massive tear as against a medium or small tear was 76.4%.

In our study, drop arm sign was positive in 66.67% of cases. Drop sign is an indicator of integrity of infraspinatus. According to Walton *et al.* [29] Drop sign when positive, was also a good indicator of RCT as a result of its 100% specificity. Walton in his study stated that the four tests: the combination of tests for supraspinatus strength, strength in external rotation, and the test for impingement sign (in either external rotation or internal rotation) and the test for drop arm sign on its own are predictor of RCT. He also stated that three other tests have a higher sensitivity than the drop arm sign and are therefore more useful.

In our study, we had significant improvement of UCLA score from preoperative mean value of 17.93 to 30.6 (p<0.001). Other studies published in the literature evaluating the functional outcome had reported similar improvement in clinical outcome. Out of 30 patients in our study, 16 patients had complete tear which was managed by arthroscopic single row repair technique. There was a significant improvement of UCLA score from preoperative mean value of 17.38 to 31.25 (p<0.0004) in these patients. Fourteen patients had partial tear which was managed by arthroscopic subacromial decompression. There was a significant improvement of UCLA score from preoperative mean value of 18.57 to 29.86 (p<0.001) in these patients.

In UCLA shoulder scoring, a total score of 34 or 35 points is considered excellent, 28 to 33 good, 21 to 27 fair, and less

than 20 points poor. In our study; 8 patients (27%) had excellent results, 18 patients (60%) had good results, 3 (10%) patients had fair results and one patient (3%) had poor result. Thomas *et al.* [30] did Medium-term follow-up of arthroscopic rotator cuff repair in a series of 84 patients who underwent repair of small, medium, or large tears between March 1997 and September 2001 with at least 2 years of follow-up. There were 42 arthroscopic repairs and 42 mini-open repairs. Of the patients, 81 (96.4%) had good or excellent UCLA (University of California, Los Angeles) scores (40 arthroscopic repairs [95.2%] and 41 mini-open repairs [97.6%]); there were 2 fair results and 1 poor outcome. The ASES (American Shoulder and Elbow Surgeons) scores averaged 91.1 for the arthroscopic group and 90.2 for the mini-open group ( $P > .05$ ). Six patients required further surgery (three from the arthroscopic group and three from the mini-open group). Of 84 patients, 83 (98.8%) reported being satisfied with the procedure.

Cho *et al.* [18] and cole *et al.* [31] studied the functional outcome of arthroscopic RCT repair using single row technique and both showed statistically significant improvement. Cho *et al* in his study showed the rotator cuff was completely healed in 131 (77.5%) out of 169 shoulders and recurrent tears occurred in 38 shoulders (22.5%). Arthroscopic repair of full-thickness rotator cuff tears led to a relatively high rate of recurrent defects. However, the minimum two-year follow up demonstrated excellent pain relief and improvement in the ability to perform the activities of daily living, despite the structural failures. Cole *et al.* showed in his study that At minimum 2-year follow-up, arthroscopic repair of rotator cuff tears produced significant improvements in both patient-derived and objectively measured variables. Our study also, at six month follow up showed good results in pain relief and ability to perform the activity of daily living [Table 6].

**Table 6:** Comparison of UCLA cores with other study.

Study (year of publication)	Pre op UCLA score (mean)	UCLA score at final follow up total (mean)
Our study (2017) Single row	17.93	30.6
Cho <i>et al.</i> [18] (2009) Single row	18.5	32.4 (p< 0.05)
Choi <i>et al.</i> [25] (2014)	14	30.4
Sugaya <i>et al.</i> [32] (2007) Single row gr Double row gr	14.8	32.4
	14.4	33.1
Mihata <i>et al.</i> [33] (2011) Single row gr	14.4	34
Koh <i>et al.</i> [34] (2011) Single row gr	18	29.3
Kim KC <i>et al.</i> [35] (2014) Partial thickness tear (Articular vs Bursal side)	A-19.80	A-32.70
	B-19.81	B-32.52

Partial rupture of rotator cuff of the shoulder can occur on the articular side or the bursal side and intratendinous [36]. Primary therapeutic approach is always conservative. If this fails for sufficiently for long period surgical procedures is used. Many studies have shown good results by arthroscopic subacromial decompression.

there were three cases in which, there were no significant improvement in UCLA scoring. At 6 month follow-up MRI was done and re-tear was found [Table 7].

In our study we did subacromial decompression for partial tear of RCT. We had significant improvement of UCLA score from preoperative mean value of 18.57 to 29.86 (p<0.001) in patient with partial tear who were treated by subacromial decompression. Other studies published in the literature evaluating the functional outcome had reported similar improvement in clinical outcome.

**Table 7:** Showing comparison of post-operative re-tear rate with other studies that used single row repair technique.

Study (Year of Publication)	% Patients with full thickness Re-tear with single row repair technique
Our study(2017)	10%
Sugaya <i>et al.</i> [38] (2005)	25.7%
Cole <i>et al.</i> [31] (2007)	22%
Lichtenberg <i>et al.</i> [39] (2006)	24.5%
Mihata <i>et al.</i> [33] (2011)	10.8%
Cho <i>et al.</i> [19] (2009)	22.5%

In our study, twenty-six (86.6%) out of thirty patients had satisfactory results while remaining four (13.4%) were unsatisfied. Snyder *et al.* [17] did his study on thirty-one patients with arthroscopically documented partial thickness rotator cuff tears treated by arthroscopic debridement of the lesion were retrospectively reviewed. The patients had symptoms for an average of 20.5 months prior to surgery. Twenty-two of these 31 shoulders also had bursoscopy, with 18 having arthroscopic subacromial decompression. The results were graded by both the UCLA Shoulder Rating Scale and Neer's criteria. Twenty-six (84%) of the patients had satisfactory results with the remaining 5 (16%) patients having unsatisfactory results.

Sugaya *et al.* [38] performed a non randomized study to evaluate the results of single- and double-row repairs. This study was based on patient inclusion in that the early patients were treated with a single-row repair and later patients were treated with a double-row repair. They were unable to find any difference between the groups in functional outcome. They did find that there was a significant difference in re-tear rate with a single-row re-tears rate of 26% and a double-row rate of 10%. Sugaya *et al.* [40] subsequently published on a group of 86 patients treated with a double-row technique who had an overall re-tear rate of 17%. In our study re-tear rate was 10%, which is way better than Sugaya study.

In our study mean operative time for arthroscopic surgery time was 51.83 minute. In first 15 cases the mean operative time was 61 minutes while in the last 15 cases mean operative time was 42.6 minutes. The mean operative time as shown by Gartsman *et al.* [37] was 26.6 (17-50).

Although rare, complications of rotator cuff repair surgery can be severe. Complications included shoulder stiffness, failure of healing, infection, reflex sympathetic dystrophy, deep venous thrombosis, and death. The most common complication was recognized as persistent stiffness that usually responded to extensive physical therapy. With the possible exception of infection, all of these complications can

In our study, there was one case where there was anchor pull out during rehabilitation. Revision surgery was done in that case with removal of anchor followed by repair. In our study,

be avoided with proper adherence to surgical principles.

## 6. Conclusion

On the basis of this study, we concluded that arthroscopic management of rotator cuff tears, either by single row anchor technique for complete tear or subacromial decompression for partial tear; gives excellent results. In our study, we found significant relief of pain, function, range of motion and overall satisfaction of the patient. We also concluded that it is a technically demanding procedure and requires a long learning curve. It has advantages over arthroscopic assisted mini-open repair like minimal cosmetic scar, deltoid muscle preservation that allows early and easier rehabilitation, and decreased postoperative pain. There is no difference in clinical outcome (debated in some studies) or cost-effectiveness between patients with rotator cuffs tear repaired arthroscopically and those repaired with use of a mini-open technique. If technical difficulties arise during arthroscopic procedure, the conversion to a mini-open repair can be done easily without compromise.

## 7. Limitations

Due to small sample size we cannot clearly state about statistical significance of a lot of finding in our study and the time period of follow up of our study was minimally six months which may require a long duration of follow up for further validation.

## 8. Acknowledgements

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Conflicts of interest- None declared

Ethical approval- The Study was approved by the institutional ethics committee

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