

A Review on the various surgical techniques in the management of complete rotator cuff tear.

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Abstract- Background: One of the common problems of the shoulder is rotator cuff tear. The treatment decision for symptomatic full-thickness cuff tears seems largely based on the physician's personal experience and Level III and IV evidence, as high-quality data for guiding treatment is limited. We aim to evaluate the evidence available in recent literature, for the efficacy of various surgical modalities. **Methods:** A systematic search was performed of PubMed, google scholar and Scopus dates (1 January 1990 - 1 December 2018), search terms: 'rotator cuff tear', 'open rotator cuff repair', 'mini open rotator cuff repair', 'all arthroscopic rotator cuff repair', 'transosseous rotator cuff repair' 'single row repair', 'double row repair' and 'surgical indication'. All articles where open repair, mini and arthroscopic rotator cuff repair was performed from January 1, 1990 – December 1, 2018, where the diagnosis was full thickness rotator cuff tear were included. Total no of patients studied, the number of patients who were treated by mini open repair, transosseous repair, single row repair and double row repair, number of studies using various scoring systems were studied. Finally all the functional outcomes according to these various scores were cumulatively tabulated as excellent, good, fair and poor outcomes and were analyzed. **Results:** 12 studies were included. This included 2 RCTs, 6 prospective, and 4 retrospective studies. 4 studies compared arthroscopic and mini open repair and 3 studies compared arthroscopic suture anchor repair and transosseous repair. Functional outcome studies on mini open repair, all arthroscopic repair, single row suture anchor repair, double row suture anchor repair and arthroscopic transosseous repair were also included in the review analysis. Mini open rotator cuff repair had 72% excellent and 15% good results, Arthroscopic suture anchor repair had 44% excellent and 50% had good results and Arthroscopic transosseous repair had 60% excellent and 33% good results. **Conclusions:** All procedures gave good or excellent functional outcomes in most of the patients. Based on the patient convenience, surgeon's experience and monetary consideration, any surgical modality may be used for treatment of full thickness shoulder rotator cuff tear.

Index Terms- complete rotator cuff tear, open rotator cuff repair, mini open rotator cuff repair, all arthroscopic rotator cuff repair, transosseous rotator cuff repair, single row repair, double row repair

I. INTRODUCTION

Shoulder pain is the one of the most common musculoskeletal complaint worldwide. Rotator cuff tear is the most common cause of shoulder disability. Rotator cuff tendons are the most commonly injured tendon. Supraspinatus muscle tendon is the most common amongst them. Rotator cuff tears have an increasing trend in the aging population. Symptoms of rotator cuff tears including pain, limited movement and shoulder dysfunction. However a large number may also remain asymptomatic. They

are subdivided into partial-thickness tears and full-thickness tears. Partial thickness tear can be managed conservatively, whereas complete tears require surgery unless contraindicated.¹

The various surgical modalities of treatment of complete rotator cuff tear: open, mini open repair and arthroscopic rotator cuff tear, with either suture anchor or transosseous repair².

Unfortunately, the treatment decision for symptomatic full-thickness cuff tears seems largely based on the physician's personal experience and Level III and IV evidence, as high-quality data for guiding treatment is limited². Understanding the true risk of operative care is very important in allowing for careful consideration of treatment options. Risks include infection, bleeding, prolonged hospital stay, retears and suboptimal functional recovery.³

The aim of this article is to provide a comprehensive review on improvement in the functional outcome scores following various modern modalities of rotator cuff repair.

II. METHODOLOGY

A comprehensive systematic review of the available literature in the English language was performed using PubMed, Google scholar and Scopus searches (1 January 1990 - 1 December 2018). We used the search term/combination(s): (complete rotator cuff tear and observation/ open rotator cuff repair / mini open rotator cuff repair / all arthroscopic rotator cuff repair / transosseous rotator cuff repair / single row repair / double row repair). The search was completed, independently, by the author in December of 2019. Initially, the abstracts were identified by title and compiled by the same Author.

After the provisional list of articles were identified and collected. We included all articles where open repair, mini open and arthroscopic rotator cuff repair was performed from January 1, 1990 –December 1, 2018 done on skeletally matured patients, where the diagnosis was full thickness rotator cuff tear. We excluded articles which were non-English study, published before 1990, studies on partial thickness rotator cuff tear, frozen shoulder, impingement syndrome, studies with concomitant lesions of labrum.

These articles were tabulated under the headings as the year of study, surgical technique assessed, number of patients studied, scoring system used and interpretation of the functional score. Total no of patients studied and the no of patients treated by mini open repair, transosseous repair, single row repair and double row repair were derived. Number of studies using various scoring systems as UCLA, ASES, Constant and Murley score, VAS score etc, was identified and the average scores according to these scores for each surgical procedure was calculated. Finally all the functional outcomes according to these various scores were cumulatively tabulated as excellent, good, fair and poor outcomes and were analysed.⁴

III. RESULTS

A total of 38 studies were identified, of which 12 studies fitted into our inclusion and exclusion criteria. These 12 studies included 850 shoulders following rotator cuff repair, were systematically analyzed on the basis of functional outcome score and tabulated in Table 1. Out of 12 studies, 7 studies were comparative studies including 4 studies comparing arthroscopic and mini open repair and 3 studies comparing arthroscopic suture anchor repair and transosseous repair. Functional outcome studies on mini open repair, all arthroscopic repair, single row suture anchor repair, double row suture anchor repair and arthroscopic transosseous repair were also included in the review analysis. Constant Murley score and UCLA score were the most commonly used score each used in 5 studies. DASH score was used in 4 studies and ASES score was used in 2 studies. As per 4 studies on mini open repair of rotator cuff using UCLA score, the average post-operative score was 31.8. 2 studies which evaluated mini open repair of rotator cuff using ASES score had an average score of 93.5. 3 studies each using UCLA, ASES and DASH scoring systems evaluated arthroscopic rotator cuff repair had an average score of 31.66, 92.4 and 3.76 respectively, whereas Constant

and Murley scoring was used in 4 studies to evaluate the same procedure with an average score of 75.69. DASH score was used to evaluate transosseous repair in 3 studies with average score of 4.5. 2 studies each used UCLA and Constant and Murley scores with an average score of 36.15 and 69 respectively. The comparative studies revealed that there is no significant difference in functional outcome scores either in arthroscopic or mini open repair or between suture anchor repair and transosseous repair using arthroscopic technique. Most of the rotator cuff repair patients evaluated, irrespective of the surgical procedure, had excellent or good results in the various outcome scores they were evaluated with, as tabulated in table 2. Mini open rotator cuff repair had 72% excellent and 15% good results, Arthroscopic suture anchor repair had 44% excellent and 50% had good results and Arthroscopic transosseous repair had 60% excellent and 33% good results.

IV. DISCUSSION

Surgical repair is the gold standard in patients unresponsive to conservative management.^{5,6} In the last 2 decades comparable functional results have been observed in patients undergoing open, mini-open, and arthroscopic repair.^{7,8} The goal of rotator cuff repairs is to achieve high initial fixation strength, minimize gap formation, maintain mechanical stability with cyclic loading, and optimize the biology of the tendon-bone “healing zone” until the cuff heals biologically to the bone.⁹

Mini open technique became popular in the 1990s because it preserves the deltoid origin, allows for strong suture fixation, and involves a shorter learning curve. **Paulos LE** and **Kody MH** reviewed their results of mini-open repairs through a lateral deltoid splitting approach combined with arthroscopic subacromial decompression in 18 patients with a follow-up of 46 months. UCLA scores revealed good to excellent results in 16 patients. The two unsatisfactory results were in cases of workers’ compensation with pending claims. The two patients who had poor outcomes complained of pain localized to the acromioclavicular joint. Pain scores improved from an average of 1.6 to 7.6. UCLA scores improved from 2.5 to 8.4. Paulos and Kody recommended mini open repairs for patients with tears retracted less than 2 cm, regardless of size, and acute tears that could easily be mobilized and concluded, when used for patients with chronic impingement and rotator cuff tear, provides acceptable clinical results with minimal morbidity¹⁰.

Blevins FT et al. reported on 64 patients who underwent mini-open repairs. Approximately 83% of patients demonstrated weakness before the procedure, and only 22% did afterward. The Hospital for Special Surgery Shoulder Score showed 83% good to excellent results at follow-up at 29 months. No correlation between cuff tear size and shoulder score was evident in this study. Blevins et al concluded that this is a safe and effective therapy for patients with tear of the rotator cuff of various sizes but mobilization of large or massive tears was more difficult.¹¹

A study by **Baker CL** and **Liu SH** compared open repair with mini open and found equally effective results in terms of relief of pain and functional outcomes¹². Indications for a mini-open surgical approach are a full-thickness tear of rotator cuff avulsion type tear off the greater tuberosity, deep partial tears, greater than 50%, are also an indication for repair. The mini-open approach is most appropriate for small- to medium-sized tears encompassing a one-tendon tear of the supraspinatus, or possibly a two-tendon tear of the supraspinatus and the upper half of the infraspinatus. The mini-open approach, while well established for supraspinatus tears, is contraindicated in those patients with subscapularis involvement. Mini-open approach in revision rotator-cuff repairs would compromise the ability to release previous postsurgical scarring and adequately expose the rotator cuff in a revision situation¹³.

Weber SC and **Schaeffel R** reviewed the results of mini-open repairs versus those of traditional open repairs in a retrospective study in 1993. A total of 69 open repairs and 60 mini-open repairs were performed for patients with small to moderate-sized tears with follow up of minimum of 2 years. Patients in the mini-open-treated group used significantly less

parenteral narcotics and had shorter hospital stays. The results between the two groups were not significantly different, but the lower morbidity rate and cost were believed to be significant advantages.¹³

Arthroscopic repair of the rotator cuff is the most commonly performed surgical procedure in the current era. **Seung-Ho Kim et al** compared the outcomes of repair of rotator cuff using arthroscopy for medium and large rotator cuff tears with the outcomes for mini-open repair of similar tears. They concluded the outcome scores were similar in both group and the results were equivocal¹⁴.

Lana Kang et al, in their study, compared the early functional outcome of mini-open and arthroscopic rotator cuff repair. A total of 128 patients were studied. At the end of 3 and 6 months, both MORCR and ARCR showed significant improvement in all patient-derived outcome parameters ($P < .0001$) except for three SF-36 variables. The improvements in the SF-36 bodily pain score at the end of 3 months postoperatively ($P = .041$) and the VAS pain score at the end of 6 months postoperatively ($P = .03$) were better for ARCR. In the study it was found that the early functional outcomes of MRCR and ARCR of small- and medium-sized rotator cuff tears are nearly equivalent. In light of the advantages of ARCR that motivate its popularity, this is an unexpected finding. However, an equally important result of this study was the finding that ARCR was associated with statistically significant improvement in the SF-36 bodily pain score and VAS pain score at the end of 3 and 6 months respectively ($P = .041$ and $.03$, respectively)¹⁵.

Köse, K. Ç et al compared all-arthroscopic cuff repair (ARCR) and mini-open rotator cuff repair (MORCR) methods with regard to clinical outcomes and costs. Tear sizes ($P=0.68$), pre- and postoperative Constant–Murley and UCLA scores ($P=0.254$) and satisfaction levels did not differ significantly between groups. However, the differences noted between pre- and postoperative Constant–Murley and UCLA scores were statistically significant within the two groups. The results suggest that ARCR shows similar clinical results but at a higher cost compared with MORCR¹⁶.

Junji Ide et al compared the results of all the arthroscopically repaired full-thickness rotator cuff tears including massive tear with those of open repair. The arthroscopic group consisted of 50 patients and the open group 50 patients. The UCLA score and the JOA score improved significantly in both groups postoperatively ($P < .0001$). The outcomes were excellent in 78 patients (78%), good in 13 (13%), fair in 6 (6%), and poor in 3 (3%). Outcome and postoperative shoulder scores showed no significant difference between the arthroscopic and open groups¹⁷.

Transosseous rotator cuff repair techniques still remain the gold standard for tendon healing. Some studies have shown a greater contact and pressure distribution with superior tendon fixation and reduced motion at the tendon-to-tuberosity interface with a simple transosseous repair configuration in comparison to anchor-based suture anchor repair simple and mattress repair techniques.⁶ **Tuoheti Y** studied and evaluated the contact area, contact pressure, and pressure patterns of the tendon bone interface after repair of the rotator cuff. They compared SR, DR and TO techniques have shown that the transosseous technique produced the second greatest contact area and the least contact pressure¹⁸. **Mazzocca AD** have also previously showed that a transosseous equivalent repair had higher contact pressure and force at all-time points during load to failure in comparison to SR, DR and TO repair techniques. Over the last decade, mini open transosseous anchorless repair techniques have been developed with comparable results to standard arthroscopic and open approaches. Superior tendon fixation with reduced motion at the tendon tuberosity interface is observed with transosseous techniques¹⁹. Recently, **Itai** showed that bone tunnels through the footprint may contribute to biologic healing by increasing blood flow in the repaired rotator cuff.²⁰

Flanagin BA et al. evaluated the clinical outcomes at midterm, following a novel arthroscopic TO (anchorless) rotator cuff repair of 109 shoulders. According to ASES scores, the results for 109 shoulders available for final follow-up were excellent in 95 (87.1%), good in 8 (7.3%), fair in 3 (2.8%), and poor in 3 (2.8%). There was no difference in ROM or outcome scores in the patients who underwent a concomitant biceps procedure (tenodesis or tenotomy) compared with those who did not. He concluded

with Arthroscopic TO rotator cuff repair leads to statistically significant midterm improvement in ROM and satisfactory subjective outcome scores with low complication/failure rates in patients with average medium-sized rotator cuff tears with minimal fatty infiltration²¹

SG Krishnan *et al.*, studied arthroscopic transosseous repair of rotator cuff for full-thickness tears of the Rotator Cuff in Patients age less than 40 Years. All patients (100%) reported diminished pain, and 22 (95%) reported improvement with activities of daily living. Complications included superficial wound infection (1) and axillary nerve palsy after initial dislocation (1). Given the choice, 22 patients(95%)would have same procedure again²².

Several techniques for suture anchor repair of rotator cuff defects have been introduced over the past few years. Besides established single-row repairs, classical double row (DR), and suture bridge DR transosseous equivalent (TOE) technique has been developed.

At present, single row is the most frequently used repair, with suture anchors disposed in 1 row over the humeral head, at the native site of insertion of the tendon.⁸

Technically, SR technique is simpler, quicker, inflicts less trauma to tendon margins, cheaper, and easier to revise. On the downside, the SR technique has smaller contact area and pressures, and the repaired tendon is allowed to heal over the smaller area, which theoretically predisposes SR repair to poor healing potential.²³

Stoppani CA *et al* evaluated the clinical and radiological outcomes of arthroscopic rotator cuff repair using 2 different techniques: single-row anchor fixation versus transosseous hardware-free suture repair. Sixty nine patients were enrolled in the study and the patients were evaluated clinically before surgery, during the 28 days after surgery, and at least 1 year after the operation by the use of validated rating scores (Constant score, QuickDASH, and numerical rating scale [NRS]): No significant differences were found between the 2 arthroscopic repair techniques in terms of functional and radiological outcomes. However, postoperative pain decreased quickly after the transosseous procedure, which therefore emerges as a possible improvement in the surgical repair of the rotator cuff²⁴.

Garofalo R *et al.* reviewed the structural and clinical outcomes of 96 cases rotator cuff tear, repaired arthroscopically, with a single row (SR) or transosseous (TO) anchorless technique. In 96 patients, 42 patients in the SR group and 54 patients in the TO group. In the SR group the Constant rating system showed significant improvement from a preoperative average rating of 44.8 to an average of 85.7. In the TO repair group the Constant rating system showed a significant improvement from a preoperative average of 46.1 to an average of 87.6 postoperatively. According to ASES index scores, the average total score improved from 42.8 to 92.0 in the anchor group and 40.4 to 94.6 in the TO group. There was no statistical difference between the two groups in clinical outcomes²¹.

Randelli P *et al.* demonstrated for the first time in a randomized double blind clinical trial, comparing anchorless transosseous versus anchored single-row repair similar results in regard to MRI assessed tendon healing (87% vs 88% Sugaya type I-III 1 year after surgery) and shoulder function assessed by Constant score, Quick DASH, and pain score. The difference in functional outcome between the intact and return patients, expressed by the Constant and QuickDASH scores, revealed no differences ($P = .57$ and $P = .56$, respectively). The difference in strength between patients with an untorn rotator cuff and those with a return rotator cuff (7.02 vs 5.73 kg, respectively) was not statistically significant ($P = .31$). The difference in pain between these 2 groups was statistically significant ($P = .03$), with a mean NRS score of 1.11 in the patients with intact rotator cuffs and 2.75 in the group with return rotator cuffs. No postoperative complications, except for retears, occurred during the study period.²⁴

In the “double row” configuration, 2 rows of suture anchors are placed over the articular cartilage margin of the anatomic neck (medial) and along the lateral edge of the tuberosity (lateral) to better restore the native rotator cuff footprint. Usually, a mattress configuration is used to tie the medial suture anchors, and a simple configuration is performed for the lateral anchors.

The suture bridge double- row technique as originally introduced by **Park et al**²⁵. It was developed to maximize tendon-to-bone compression by bridging the medial suture limbs to lateral suture anchors. This results in compression of the tendon onto the rotator cuff footprint.

Classic DR is criticized for increased operative time, complexity of the procedure, and higher cost of more implants used without having any major added clinical advantage over SR. In addition, presence of excess implant at the footprint renders repair of re-tear difficult.²⁶

Francesco Franceschi et al hypothesized that there was no difference in clinical and imaging outcome between single-row and double-row suture anchor technique repairs of rotator cuff tear. The authors recruited 60 patients. In 30 patients, rotator cuff repair was performed with a single-row suture anchor technique (group I). In the other 30 patients, rotator cuff repair was performed with a double-row suture anchor technique (group II). The UCLA rating system showed a statistically significant improvement from a preoperative mean rating of 11.5 (range, 6-14) to a mean of 32.9 (range, 29-35) postoperatively ($P < .05$) in GROUP 1. The UCLA rating system showed a statistically significant improvement from a preoperative mean rating of 10.1 (range, 5-14) to a mean of 33.3 (range, 30-35) postoperatively ($P < .05$) in GROUP 2⁸.

As per our review and as per our discussion above rotator cuff repairs give good to excellent results irrespective of the type of surgery performed. RCTs with larger number of patients may help to prove the superiority of one procedure over the other.

V. CONCLUSION

All surgical repair of complete rotator cuff tears gave equivocal results as evidenced by our review. All procedures gave good or excellent functional outcomes in most of the patients. Based on the patient convenience, surgeon's experience and monetary consideration, any surgical fixation of rotator cuff either transosseous or suture anchor fixation through any approach open, mini open and arthroscopic procedures may be performed.

I. APPENDIX

TABLE 1: CUMULATIVE TABLE SHOWING FUNCTIONAL OUTCOME SCORES OF THE VARIOUS ARTICLES VIEWED

S.No	AUTHOR	YEAR	SCORING SYSTEM	No. of shoulders	Surgeries compared	INTERPRETATION																								
1	Paulos L.E. and Kody MH	1994	UCLA	18	Mini open transosseous repair with sub acromial decompression	VAS scores improved from an average of 1.6 to 7.6. Average UCLA score : 33.33																								
2	Blevine FT et al	1996	Modified Hospital for Special Surgery Shoulder Score	78	arthroscopic assisted mini-open rotator cuff repair	.The modified HSS shoulder score in the 47 patients who completed a questionnaire and a physical examination increased from 44 of 100 preoperatively to 86 of 100 postoperatively (P < .05).																								
3	Seung Ho Kim et al	2003	UCLA score	76	arthroscopic repair of medium and large rotator cuff tears and mini-open repair of similar tears	<table border="1"> <thead> <tr> <th>score</th> <th>surgical technique</th> <th>Preop</th> <th>2 yrs</th> </tr> </thead> <tbody> <tr> <td rowspan="2">UCLA</td> <td>Arthroscopic Repair</td> <td>19+/-4.3</td> <td>33+/-2.8</td> </tr> <tr> <td>Mini-Open Repair</td> <td>18+/-2.6</td> <td>33+/-3.4</td> </tr> <tr> <td rowspan="2">ASES</td> <td>Arthroscopic Repair</td> <td>61+/-16</td> <td>95+/-7.2</td> </tr> <tr> <td>Mini-Open Repair</td> <td>59 +/-12</td> <td>95+/-7.3</td> </tr> </tbody> </table>	score	surgical technique	Preop	2 yrs	UCLA	Arthroscopic Repair	19+/-4.3	33+/-2.8	Mini-Open Repair	18+/-2.6	33+/-3.4	ASES	Arthroscopic Repair	61+/-16	95+/-7.2	Mini-Open Repair	59 +/-12	95+/-7.3						
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4	Junji Ide et al	2005	-UCLA score -JOA score(Japanese Orthopaedic Association)	100	all-arthroscopic repair of full-thickness rotator cuff tears including massive tear and open repair	<table border="1"> <thead> <tr> <th>score</th> <th>surgical technique</th> <th>Preop</th> <th>49 m</th> </tr> </thead> <tbody> <tr> <td rowspan="2">UCLA</td> <td>Arthroscopic Repair</td> <td>16.1</td> <td>32.0</td> </tr> <tr> <td>Open Repair</td> <td>15.5</td> <td>31.6</td> </tr> <tr> <td rowspan="2">JOA score</td> <td>Arthroscopic Repair</td> <td>58.7</td> <td>94.0</td> </tr> <tr> <td>Open Repair</td> <td>56.9</td> <td>92.1</td> </tr> </tbody> </table>	score	surgical technique	Preop	49 m	UCLA	Arthroscopic Repair	16.1	32.0	Open Repair	15.5	31.6	JOA score	Arthroscopic Repair	58.7	94.0	Open Repair	56.9	92.1						
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5	S.G. Kreshnan et al	2007	ASES score	24	arthroscopic suture anchor repair of full-thickness tear	Mean preoperative American Shoulder and Elbow Surgeon's (ASES) self-report score was 42 (range, 22 to 60); the mean postoperative score was 92 (range, 65 to 100; P < .01).																								
6	Lana Kang M.D. et al	2007	-VAS score -SF-36 -SST -DASH	128	Mini-open and arthroscopic rotator cuff repair.	<p>Mini open rotator cuff repair</p> <table border="1"> <thead> <tr> <th>Score</th> <th>Preop</th> <th>3mon</th> <th>6mon</th> </tr> </thead> <tbody> <tr> <td>DASH</td> <td>40.7 +/-17.5</td> <td>29.1 +/-18.8</td> <td>18.8 +/-19.1</td> </tr> <tr> <td>SST</td> <td>5.2 +/-3.1</td> <td>7.4 +/-2.7</td> <td>9.3 +/-2.5</td> </tr> <tr> <td>VAS</td> <td>5.9 +/-2.2</td> <td>3.0 +/-1.9</td> <td>2.5 +/-2.3</td> </tr> <tr> <td>SF-36</td> <td>73.9 +/-20.4</td> <td>73.2 +/-21.4</td> <td>79.2 +/-21.4</td> </tr> </tbody> </table> <p>http://dx.doi.org/10.29322/IJSRP.10.04.2020.p10035</p> <p>Arthroscopic rotator cuff repair</p> <table border="1"> <tr> <td>S</td> <td>Pr</td> <td>3</td> <td>6</td> </tr> </table>	Score	Preop	3mon	6mon	DASH	40.7 +/-17.5	29.1 +/-18.8	18.8 +/-19.1	SST	5.2 +/-3.1	7.4 +/-2.7	9.3 +/-2.5	VAS	5.9 +/-2.2	3.0 +/-1.9	2.5 +/-2.3	SF-36	73.9 +/-20.4	73.2 +/-21.4	79.2 +/-21.4	S	Pr	3	6
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									core	e op	months	
									DA	42.8+/-	30.6+/-	
									SH	17.9	19.8	
									SST	4.7+/-2.9	6.8+/-3.0	
									VA	6.2+/-1.9	2.7+/-2.7	
									S			
									SF-	66.6+/-	70.0+/-	
									36	20.2	21.6	

7	<i>Köse, K.Ç., Tezen et al</i>	2008	Constant Murley score UCLA score	50	all-arthroscopic cuff repair (ARCR) and mini-open rotator cuff repair (MORCR) methods	score	surgical technique	Preop	Postop
						Constant Murley score	All arthroscopic cuff repair	46.2+/-11.8	83.56+/-11.45
							Mini-open rotator cuff repair	45.6+/-12.4	79.56+/-13.64
						UCLA score	All arthroscopic cuff repair	11.2+/-5.6	29.76+/-4.5
Mini-open rotator cuff repair	10.6+/-4.5	28.8+/-3.42							
8	<i>Flanagin BA et al</i>	2016	ASES <ul style="list-style-type: none"> • Forward flexion • External rotation • Internal rotation N=56	109	novel arthroscopic TO (anchorless) rotator cuff repair technique	American Shoulder and Elbow Surgeons (ASES) score post operatively at an average 38.0 months was 94.6 showing			
						Scores		No of shoulder	
						Excellent		95	
						Good		8	
						Fair		3	
Poor		3							
9	<i>Randelli P et al</i>	2017	Constant score Quick DASH Numerical rating scale N=69	69	arthroscopic rotator cuff repair using 2 different techniques: single-row anchor fixation versus transosseous hardware-free suture repair	Score	surgical technique	Preop	1 yr
						Constant score	Anchor (single row)	65.1	72.3
							Transosseous	64.3	69.9
						QuickDASH	Anchor(single row)	45.4	2.3
Transosseous	55.6	4.5							
10	<i>Dinsha BS et al</i>	2017	Constant Score N=31	31	rotator cuff repair using all-suture anchors	Of the 31 patients who underwent rotator cuff repair using all-suture anchors the average Constant score was 77 at the end of 1 year follow up.			
11	<i>Carlo Stoppani et al</i>	2017	Constant score Quick DASH N=96	69	Arthroscopic suture anchor repair and transosseous repair	score	surgical technique	Preop	15 m
						Constant score	Anchor	65.1	72.3
							Transosseous	64.3	69.9
						QuickDASH	Anchor	45.4	2.3
Transosseous	55.6	4.5							
12	<i>Garofalo R et al</i>	2018	ASES 96 patients who underwent an arthroscopic repair for superior or posterosuperior rotator cuff tear using TO (n:54) or a SR (n:42) were retrospectively enrolled in this study after	96	arthroscopic repair for superior or posterosuperior rotator cuff tear using TO or a SR	score	surgical technique	Preop	15 m
						ASES score	Anchor (single row)	44.8 ± 4.1	85.7 ± 6.1
							Transosseous	46.1 ± 7.2	87.6 ± 4.1
						QuickDASH	Anchor(single row)	40.4 ± 7.2	92.1 ± 4.3
Transosseous	42.8 ± 8.2	94.6 ±							

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			evaluation of clinical and surgical notes. N=96						6.1
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Table 2: Showing only Excellent and good results by the end of study period for the most commonly performed procedures for mini open rotator cuff repair.

Surgical procedure	Excellent	Good
Mini open rotator cuff repair	120	25
Arthroscopic suture anchor repair	181	207
Arthroscopic transosseous repair	167	91

VII. ACKNOWLEDGMENT

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