Comparative Study between Single Row versus Double Row Fixation in Arthroscopic Rotator Cuff Repair

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Abstract

Background: The shoulder joint has the greatest range of motion of any other joint. Pain of the shoulder joint is very common and accounts for about 16% of musculoskeletal disorders**.**

Aim and objectives: to analyze results after arthroscopic rotator cuff repair (RCR) in patients with symptomatic rotator cuff tears and to compare functional and radiographic outcomes between single row (SR) and double row (DR) repair techniques.

Patients and methods: This was a Prospective clinical study conducted on 40 cases with symptomatic Rotator Cuff tear in Beni Suef University hospital and governmental hospitals from august 2021 to July 2023. Patients were divided into two groups.

Results: There was statistically significant higher improvement in the two groups in post-operative from the preoperative according to forward flexion, with p-value ($p<0.001$); but double group slightly improved than single group, with p-value ($p>0.05$ insignificant difference). There was statistically significant higher improvement in the two groups in post-operative from the preoperative according to forward flexion, with p-value ($p<0.001$); but double group slightly improved than single group, with p-value ($p>0.05$ insignificant difference**.**

Conclusion: Arthroscopic Rotator Cuff Repair using the double row method gives a noticeable improvement in the short term and a slightly greater improvement in the long term of follow-up than using a single-row repair, which is a safe procedure with satisfactory functional and clinical results after the operation.

Key words: Arthroscopic Rotator Cuff Repair, Single Row Fixation, double Row Fixation

INTRODUCTION

Rotator cuff disorders including degeneration or tear are the most common causes of chronic shoulder pain. Causes of rotator cuff tear (RCT) are still unclear and occur as a result of many factors. As degenerative changes of the rotator cuff that occur in old age increase the risk of rotator cuff tear. Overhead workers and athletes are also considered a risk factor. Factors that increase the risk of rotator cuff tear can be divided into intrinsic, extrinsic and traumatic factors **[1]**.

The double-row technique has been recommended as a means of increasing the contact area between the repaired rotator cuff and the native bone bed. Theoretically, this technique incorporates a medial and a lateral row of suture anchors, increasing the initial coverage of the tendon bone junction**[2,3]**.

Restoring the anatomic footprint may enhance healing of the tendon bone interface and the mechanical strength of the repaired tendons **[4,5]**.

The aim of this study was to analyze results after arthroscopic rotator cuff repair (RCR) in patients with symptomatic rotator cuff tears and to compare functional and

radiographic outcomes between single row (SR) and double row (DR) repair techniques.

PATIENTS AND METHODS

This was a Prospective clinical study conducted on 40 cases with symptomatic Rotator Cuff tear in Beni Suef University hospital and governmental hospitals from august 2021 to July 2023

Sample size

This study was designed to involve 40 cases with symptomatic Rotator Cuff tear. The patients were ramdomly separated into two groups. In group A, arthroscopic single row rotator cuff repair was done. While in Group B, arthroscopic double row rotator cuff repair was done. Randomization was performed with a reliable statistical software program through a random selection of 50% of cases.

Inclusion criteria

Patients of either Sex, age above 20 years and tear size between 1cm and 5 cm in the coronal plane.

Exclusion criteria

Significant co-morbid medical condition such as autoimmune diseases, rheumatologic diseases, uncontrolled diabetes mellitus, cardiac disease and hypertension. Previous rotator cuff surgery on the affected shoulder. Severe fatty degeneration of muscles. Massive rotator cuff tears (> 5 cm). Superior migration of the humeral head. Patients with partial tears or small tears (less than 1cm). Concomitant torn Subscapularis that needs repair. Substantial shoulder co-morbidity e.g. osteoarthritis, frozen shoulder, Superior labrum anterior-posterior tear (SLAP). Paralytic shoulder &infection.

Ethical considerations

All the individuals included in the study were informed about the procedures regarding the study and will be informed of their rights to refuse participation or withdraw from the study without having to give reasons. Participants were guaranteed anonymity and all information provided would be treated with confidentiality. The required administrative regulations were fulfilled. The ethical approval of the faculty of medicine, Beni-Suef University research ethical committee (REC) will be obtained prior to the beginning of the work.

METHODOLOGY

Procedure

For single-row repair, the anchors were placed at the articular margin of the superior face of the humeral head. The number of anchors varied from 1 to 3, according to the size of the tear. Bio anchors loaded with No. 2 Fiberwire sutures (Arthrex, Naples, FL) were used. After the anchors were placed through the superior portal, sutures were individually passed from the double-loaded anchors into the lateral edge of the tendon, taking a 10- to 15-mm bite of tissue using an antegrade suture passer or other instruments as deemed necessary to place a simple suture. When sutures had been

placed, they were sequentially tied using a locking, sliding knot with back-up half-hitches. **For the double-row repair**, the medial row consisted of 1 or 2 anchors placed at the articular margin of the humeral head. Both limbs of each suture were passed through the tendon, approximately 15 mm medial to the tear margin.

RESULTS

There was no statistically significant difference between Single Row Fixation Group and Double Row Fixation Group according to demographic data, about age "years", gender and side, with p-value ($p>0.05$). **(Table 1)**

There was statistically significant higher improvement in the two groups in post-operative from the preoperative according to forward flexion, with p-value ($p<0.001$); but double group slightly improved than single group, with p-value ($p>0.05$ insignificant difference). **(Table 2)**

There was statistically significant higher improvement in the two groups in post-operative from the preoperative according to MURLEY score, with p-value ($p<0.001$); but double group slightly improved than single group, with p-value ($p>0.05$ insignificant difference). **(Table 3)**

There was statistically significant higher improvement in the two groups in post-operative from the preoperative according to forward flexion, with p-value ($p<0.001$); but double group slightly improved than single group, with p-value ($p>0.05$ insignificant difference). **(Table 4)**

There was statistically significant higher improvement in the two groups in post-operative from the preoperative according to Int. rotation in 90 Abduction, with p-value ($p<0.001$); but double group slightly improved than single group, with p-value ($p>0.05$ insignificant difference). **(Table 5)**

Two patients single row fixation (one patient underwent revision RCR for re-tear and the other one underwent arthroscopic release for stiffness) and in one patient in the double row fixation group (underwent arthroscopic release for stiffness), with p-value ($p>0.05$). **(Table 6)**

Table 1. Comparison between single row fixation group and double row fixation group according to demographic data.

Demographic data	Single Row Fixation Group (n=20)	Double Row Fixation Group (n=20)	Test value	P-value
Age (years) Mean±SD Range	 57.75±5.30 48-65	 55.60±5.36 48-63	1.275	0.210
Gender Female Male	 8 (40.0%) 12 (60.0%)	 5 (25.0%) 15 (75.0%)	0.456	0.496
Side Lt. Rt.	 6 (30.0%) 14 (70.0%)	 10 (50.0%) 10 (50.0%)	1.667	0.197

Using: t-Independent Sample t-test for Mean±SD; x^2: Chi-square test for Number (%)
p-value >0.05 is insignificant

Table 2. Comparison between single row fixation group and double row fixation group according to forward flexion.

Forward Flexion	Single Row Fixation Group (n=20)	Double Row Fixation Group (n=20)	Test value	P-value
Pre operative Mean±SD Range	94.25±24.67 45-140	100.00±25.13 60-150	-0.730	0.470
Post operative Mean±SD Range	156.00±20.88# 90-180	162.50±11.64# 150-180	-1.216	0.231
Follow Up >12m Mean±SD Range	158.33±16.02# 140-180	163.57±14.92# 140-180	-0.610	0.554
Amount change (Pre-Post) Mean±SD Range	61.75±19.01 30-100	62.50±21.73 30-110	-0.116	0.908
Amount change (Pre-FU) Mean±SD Range	60.00±29.66 20-100	62.14±15.77 40-85	-0.166	0.871

Using: t-Independent Sample t-test for Mean±SD; p-value >0.05 is insignificant # Highly statistically significant difference between post-operative from pre-operative, p-value (p<0.001)

Table 3. Comparison between single row fixation group and double row fixation group according to murley.

Murley	Single Row Fixation Group (n=20)	Double Row Fixation Group (n=20)	Test value	P-value
Pre operative Mean±SD Range	46.30±11.20 23-70	47.60±12.07 33-71	-0.353	0.726
Post operative Mean±SD Range	83.25±9.08# 60-100	86.65±10.53# 63-100	-1.093	0.281
Follow Up >12m Mean±SD Range	84.17±5.27# 75-90	88.86±7.38# 82-100	-1.296	0.222
Amount change (Pre-Post) Mean±SD Range	36.95±10.00 23-63	39.05±12.07 17-65	-0.599	0.553
Amount change (Pre-FU) Mean±SD Range	37.83±9.91 27-56	38.00±14.81 17-65	-0.023	0.982

Using: t-Independent Sample t-test for Mean±SD; p-value >0.05 is insignificant# Highly statistically significant difference between post-operative from pre-operative, p-value (p<0.001)

Table 4. Comparison between single row fixation group and double row fixation group according to forward flexion.

Forward Flexion	Single Row Fixation Group (n=20)	Double Row Fixation Group (n=20)	Test value	P-value
Pre operative Mean±SD Range	94.25±24.67 45-140	100.00±25.13 60-150	-0.730	0.470
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Using: t-Independent Sample t-test for Mean±SD; p-value >0.05 is insignificant # Highly statistically significant difference between post-operative from pre-operative, p-value (p<0.001)

Table 5. Comparison between single row fixation group and double row fixation group according to Int. rotation in 90 abd.

Int. Rotation in 90 Abd.	Single Row Fixation Group (n=20)	Double Row Fixation Group (n=20)	Test value	P-value
Pre operative Mean±SD Range	67.00±10.31 50-80	68.50±9.61 50-85	-0.476	0.637
Post operative Mean±SD Range	78.75±8.25 60-90	83.25±7.99 70-95	-1.752	0.088
Follow Up >12m Mean±SD Range	76.67±10.33 60-90	79.29±8.38 70-90	-0.505	0.623
Amount change (Pre-Post) Mean±SD Range	11.75±10.17 0-30	14.75±14.00 0-45	-0.775	0.443
Amount change (Pre-FU) Mean±SD Range	8.33±9.83 0-20	9.29±9.76 0-25	-0.175	0.864

Using: t-Independent Sample t-test for Mean±SD; p-value >0.05 is insignificant # Highly statistically significant difference between post-operative from pre-operative, p-value (p<0.001)

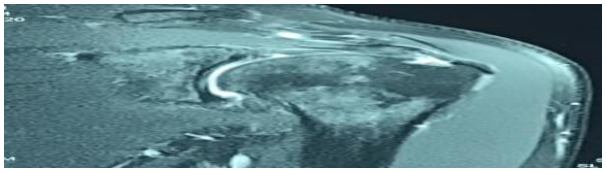
Table 6. Comparison between single row fixation group and double row fixation group according to complications.

Complication	Single Row Fixation Group (n=20)	Double Row Fixation Group (n=20)	x^2	P-value[FE]
Stiffness	2 (10.0%)	1 (5.0%)	0.351	0.553
Non complications	18 (90.0%)	19 (95.0%)		

Using: x^2: Chi-square test for Number (%) & Fisher's exact test, when appropriate p-value >0.05 is insignificant

CASE PRESENTATION

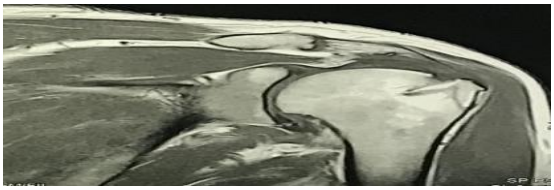
Case 1: Forty-five years-old right handed manual worker presented with left shoulder dull aching pain and weakness of three months' duration. The pain was mainly lateral shoulder pain that increased at night and interfered with sleeping and performing his job. He denied any previous left shoulder pain or weakness before the fall. He was a smoker with no past medical history of significance. On physical examination: He had full cervical range of motion and a negative Spurling's maneuver. His shoulder girdle did not demonstrate signs of atrophy and he had tenderness in the anterior and lateral subacromial region. His left shoulder passive range of motion was normal and symmetric with the contralateral shoulder but the active ROM was limited. Strength testing revealed weakness in the supraspinatus with no lag signs. Preoperative ROM and scores (Froward flexion 150, Abduction 140, External rotation at 00 50, Internal rotation at 90 0 80, Constant score 36).Radiographs of his left shoulder revealed a concentrically located glenohumeral joint with no evidence of glenohumeral joint arthritis or proximal humeral migration. Magnetic resonance imaging revealed a full thickness rotator cuff tear involving the supraspinatus. Arthroscopic rotator cuff repair was done and glenohumeral arthroscopy showed full thickness supraspinatus tear, intact long head ofbiceps tendon and no arthritis. The tear size was 2 cm without retraction and it was repaired arthroscopically using single row suture technique together with subacromial decompression. The patient achieved satisfactory improvement in pain, ROM and functional scores measures. Post-operative ROM and score were as following (Froward flexion 180, Abduction 170, External rotation at 0^0 70, Internal rotation at 90 ^{0}80, Constant score 94).



A) Coronal MRI cut

B) Full thickness supraspinatus tear

C) Single row suture bridge



D) Postoperative coronal MRI cut

E F G

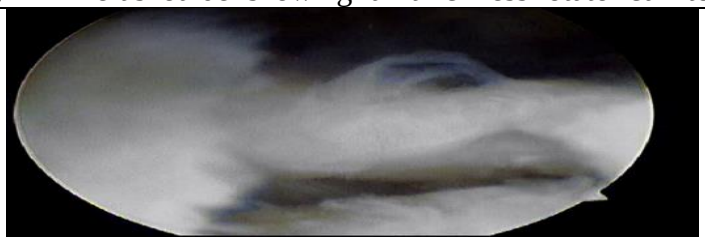
Showing postoperative improvement

Figure 1: case 1

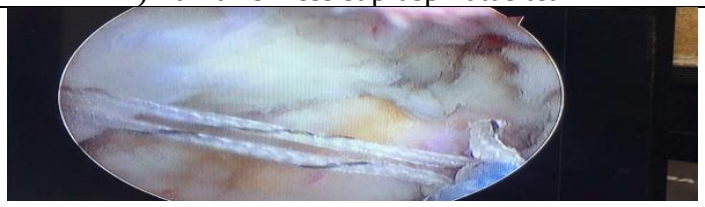
Case 2) Forty-two years-old right handed worker complained of left shoulder pain of three months duration. It was mainly anterolateral dull aching shoulder pain that presented throughout the day and was aggravated by activity. He complained of night pain which disturbed his sleep as well and he had been taking NSAIDs and paracetamol regularly. He also complained of weakness of his left shoulder, which interfered with daily activities. There was no history of prior trauma. The patient had a course of physiotherapy with slight improvement in pain, but the improvement was temporary with gradual increase in pain again. On physical examination he had full cervical range of motion and a negative Spurling's manoeuvre. There was no atrophy of the right supraspinatus muscle. Palpation of the left shoulder girdle showed tender anterolateral acromion with positive impingement tests. His left shoulder passive range of motion in forward elevation, abduction, and arm-at-side external rotation was normal and symmetric with the contralateral shoulder but the active ROM was limited. Strength testing revealed weakness in supraspinatus testing. There were no lag signs. The Forty-

two years-old right handed worker complained of left shoulder pain of three months duration. It was mainly anterolateral dull aching shoulder pain that presented throughout the day and was aggravated by activity. He complained of night pain which disturbed his sleep as well and he had been taking NSAIDs and paracetamol regularly. He also complained of weakness of his left shoulder, which interfered with daily activities. There was no history of prior trauma. The patient had a course of physiotherapy with slight improvement in pain, but the improvement was temporary with gradual increase in pain again. On physical examination he had full cervical range of motion and a negative Spurling's manoeuvre. There was no atrophy of the right supraspinatus muscle. Palpation of the left shoulder girdle showed tender anterolateral acromion with positive impingement tests. His left shoulder passive range of motion in forward elevation, abduction, and arm-at-side external rotation was normal and symmetric with the contralateral shoulder but the active ROM was limited. Strength testing revealed weakness in supraspinatus testing. There were no lag signs. The Preoperative ROM and score (Froward flexion140, Abduction 140, External rotation at 00 60, External rotation at 900 70, Internal rotation at 90 0 70, Constant score 36).
Arthroscopic rotator cuff repair was done and glenohumeral arthroscopy showed full thickness supraspinatus tear extending to the infraspinatus tendon, frayed degenerated long head of biceps tendon and no arthritis or other GH pathology. The tear size was 3 cm without retraction and it was repaired arthroscopically using double row suture technique. Post operatively the patient followed the postoperative rehabilitation protocol and he had marked improvement in range of motion, pain, functional scores. Post-operative ROM and score (Froward flexion 180, Abduction 170, External rotation at 00 70, External rotation at 900 90, Internal rotation at 90 090, Constant score 96).

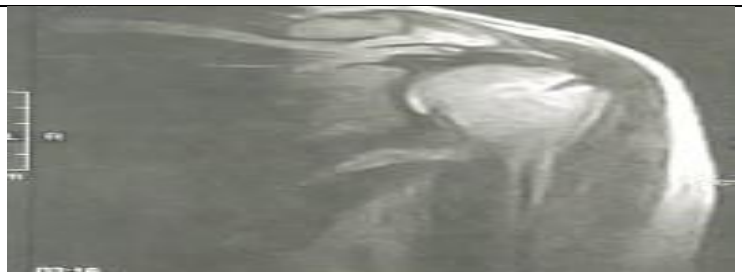
A) MRI Left shoulder showing full thickness rotator cuff tear



B) Full thickness supraspinatus tear



c) Double row suture



D) Postoperative MRI: show double row fixation

E) Showing postoperative improvement

Figure 2. Case 2

DISCUSSION

In our study, as regards demographic data, NO of affected shoulders was 40 shoulders, age (years) (48:65 y), follow up period FU was18 months Tear size (range, 1-5 cm), Number of anchor used(1:4), Preoperative functional score (mean) of affected shoulder (46.30), Postoperative functional score of affected shoulder Constant scor (SR 83.25 and DR86.65), Complications (One patient in single-row group and 2 patients in double-row groups) and Postoperative imaging (X RAY &MRI). Also a meta- analysis study conducted by Koh KH reported that no of affected shoulders was 71 shoulders, age (43 to 78 y), FU (24:44 ms), Tear size(2:4 cm), Number of anchor used (2:5), Preoperative functional score (mean) of affected shoulder 61.4, Postoperative functional score of affected shoulder Constant scor (SR 83.9 and DR84.4), Complications (In SR group, there were 4 full-thickness retears and 11 partial-thickness retears, in DR group, there were 6 full-thickness retears and 1 partial-thickness retear) Postoperative imaging used was MRI **[6]**.

On the contrary, Zhang et al, Xu et al , Chen et al and Ying et al found better clinical outcome for double-rowrepairs in tears larger than 3 cm and lower re-tear rates **[7-10]**.

U.J. Spiegl published in 2016 a summary of meta- analyses comparing single-row repair with double-row repair. The authors concluded that there was no clinical differences between both repair techniques for small-sized and medium- sized rotator cuff tears after a short-term follow-up period witha higher re-tear rate following single-row repairs, however; there seemed to be a trend toward superior results with double-row repair in large to massive tear sizes **[11]**.

Our study evaluated the clinical and functional results after arthroscopic rotator cuff repair (RCR) in patients with symptomatic rotator cuff tears and to compare functional and radiographic outcomes between single row (SR) and double row (DR) repair techniques.

According to ROM the results of our study showed statistically significant higher improvement in the two groups in post-operative from the preoperative according to

MURLEY score, with p-value (p<0.001); but double group slightly improved than single group, with p-value (p>0.05 insignificant difference).
Also, results of the present study showed a statistically significant higher improvement in the two groups in post-operative from the preoperative according to forward flexion, with p-value (p<0.001); but double group slightly improved than single group, with p-value (p>0.05 insignificant difference).
The present study showed statistically significant higher improvement in the two groups in post-operative from the preoperative according to abduction, with p-value (p<0.001); but double group slightly improved than single group, with p-value (p>0.05 insignificant difference). There was a statistically significant higher improvement in the two groups in post-operative from the preoperative according to Ext. rotation, with p-value (p<0.001); but double group slightly improved than single group, with p-value (p>0.05 insignificant difference).
Also, There was a statistically significant higher improvement in the two groups in post-operative from the preoperative according to Int. rotation in 90 Abd., with p-value (p<0.001); but double group slightly improved than single group, with p-value (p>0.05 insignificant difference).
Regarding the incidence of re-tear in follow-up MRI, we found non-significant difference between both groups. Three patients underwent second operation.
Two patients in single row fixation (one patient underwent revision RCR for re-tear and the other one underwent arthroscopic release for stiffness) and one patient in double row fixation group had pain and decreased ROM (secondary frozen shoulder) underwent arthroscopic release for stiffness, with p-value (p>0.05).
Comparing our results with other studies using the same or similar technique, Franceschi et al. completed a randomised controlled trial providing Level evidence comparing the single-row repair technique and the double-row repair technique. Sixty patients were evaluated **[12]**. Patients were reassessed at two years. Regarding Lichtenberg et al. of intervention by their functional status with the UCLA scale and follow-up imaging by MRI. There were no significant differences in functional assessment, postoperative ROM and pattern of healing with MRI **[13]**.
Park et al. conducted a study in which 40 consecutive patients were treated with the single row technique and the following 38 with the double-row technique. At two years after surgery, no significant improvements were found in the two groups in ASES, Constant and SSI. When a comparison was made regarding the size of the rupture, functional assessment was significantly better with the double-row in large and massive tears (>3 cm) (P<0.05) **[14]**.
A higher recurrent insufficiency rate of 28.9% was reported after a prolonged follow-up by Voigt et al ; that study still achieved good clinical results, represented by a mean CS score of 94% **[15]**.
Comparing the primary biomechanical, stable single-row method (massive cuff stitch) with the double-row suture bridge technique, Pennington et al. were among the first authors evaluating 2 groups of patients in a prospective, nonrandomized assessment. There were no differences concerning the clinical results but the investigators found an unexpected, lower re-tear rate for the single-row technique (20.5% vs 30.8%; P = .017). The reason for this mentioned by the authors was the inhomogeneity of the tear size between the 2 groups. A more homogeneous subset of patients with tears between 2.5 and 3.5 cm showed a significantly improved healing rate for the double-row repair (P <0.03) **[16]**.

CONCLUSION

Arthroscopic Rotator Cuff Repair using the double row method gives a noticeable improvement in the short term and a slightly greater improvement in the long term of follow-up than using a single-row repair, which is a safe procedure with satisfactory functional and clinical results after the operation.

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