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The effect of row number on clinical and life quality outcomes of patients who underwent arthroscopic rotator cuff repair

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ABSTRACT

Objective: Shoulder pain and disability are mostly seen following rotator cuff rupture. Arthroscopic rotator cuff repair becomes a gold standard treatment for rotator cuff rupture when conservative treatment fails. Comparing functional results, retear rates and reoperation rates of arthroscopic rotator cuff repair in terms of single-row versus double row techniques is our aim in this study.

Material and Method: Overall, 174 arthroscopic rotator cuff surgery patients were specified into 2 groups. Group 1 consists of 81 patients underwent single-row repair and group 2 consists of 93 patients consisted of transosseos equivalent technique double row. We evaluated demographic data and American Shoulder and Elbow Surgeons, Constant Murley, Visual analogue scale and 36-item Short Form subscale scores.

Results: Mean follow-up time was 14.08±4.77 months. ASES, CM and VAS following ARCR were similar between two groups. Some of SF-36 subscale score improvements after operation are significantly better in group 2; role limitations due to physical health (p=0.041), energy/fatigue (p=0.026), emotional well-being (p=0.017), pain (p=0.010), general health (p=0.037). Re-rupture rates were significantly different. In group 1 re-rupture rate was 13.6% and for group 2 it was 1.1% (p=0.001).

Conclusion: Lower re-rupture rates, and improved quality of life outcomes at short-term follow-up can be obtained by arthroscopic double-row repair. We suggest that the double-row technique can be considered for patients who have medium to large rotator cuff tears for lower re-rupture rates and some quality of life outcomes.

Keywords: Single-row repair , double-row repair, arthroscopy, rotator cuff rupture, supraspinatus

INTRODUCTION

Rotator cuff (RC) rupture is one of the most common causes of shoulder pain and disability (1). Although most ruptures are treated conservatively, many methods (especially arthroscopic) for tears requiring surgical intervention have been described in the last two decades. Nowadays arthroscopic rotator cuff repair (ARCR) becomes a gold standard treatment for RC rupture when conservative treatment fails (2).

Adequate fixation of the tendon to the footprint is important to achieve better tendon-bone healing (1). Many authors believe that the popularization and evolution of the arthroscopic technique was provided by the development of suture anchors however, proper placement of anchor sutures in the supraspinatus footprint at tuberculum majus of humerus is still a debate. During RC repair has not been clear yet (3). Single-row (SR) and double-row (DR) techniques are most preferred methods. Both SR and DR techniques are widely used in the treatment of RC ruptures and optimal treatment remains contraversial (4). Some of the biomechanical studies showed that DR repair provides stronger stability compared to SR repair (5), although some authors reported similar biomechanical strength and footprint coverage in cadaveric studies (6, 7). A recent systematic review evaluated meta-analyses about RC repair and most of the studies concluded that re-tear rates were less in DR repair but functional results were similar (8).

Retears after ARCR are not rare and retear rate reported up to 94% (9). Fortunately, most of the retears remain asymptomatic (10). Although some retears require further intervention and reoperations increase morbidity and treatment costs.

Our aim was to compare functional results, retear rates and reoperation rates of ARCR in terms of SR versus DR techniques.

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MATERIAL AND METHOD

The study was carried out with the permission of Health Sciences University Kanuni Training and Research Hospital Clinical Researchs Ethics Committee (Date: 23.05.2021, Decision No: 2021/86). We retrospectively analysed the records of 208 patients who underwent arthroscopic RC repair between February 2017 and July 2019. Of these, 34 patients had a RC tear that could not be repaired (n=21) or had isolated subscapularis tendon repairs (n=13) and were excluded. This study has been performed due to the 1964 Declaration of Helsinki and its later updates.

The inclusion criteria were: age >18 years old; arthroscopic anterosuperior, superior, and/or posterosuperior RC tears, including those of the supraspinatus, infraspinatus and/or teres minor tendons; and a minimum 6 months follow-up, who has a fatty degeneration less than Goutallier grade 3 (11). Excluded patients were: those under the age of 18 years and more than 70 years old; those with a history of orthopaedic surgery on the same extremity, inflammatory arthropathy of same shoulder joint, concurrent pathology of the labrum that required repair, advanced osteoarthritis of the same glenohumeral joint, ipsilateral neurological deficit, chronic degenerative disease affecting the same shoulder joint, partial thickness and massive irreparable tears (11), and isolated subscapularis tendon tears. After all, 174 patients were available for the present study.

Information was obtained on age, gender, operated side, follow-up time, tear size, re-rupture rate and duration of operation. The classification of full-thickness cuff rupture was performed by assessing data acquired with magnetic resonance imaging (MRI). Tear classification was made according to the DeOrio and Cofield classification, with the size of full-thickness tears of <1 cm considered small, 1-3 cm considered medium, 3-5 cm considered large, and > 5 cm considered massive (12).

Two different surgeon's patients' were assessed as two groups. One surgeon perfoms single-row in his clinical practice and, other one performs double-row for arthroscopic supraspinatus tendon repair. Patients were specified into 2 groups according to row number. Group 1 consists of patients underwent SR repair (**Figure 1**) and group 2 consists of transosseos equvalent technique (TOE) DR (**Figure 2**).

The patients were subjected to a follow-up examination by an independent observer. For the functional and quality of life evaluation of patients, pre- and postoperative American Shoulder and Elbow Surgeons (ASES) scores (13), Constant-Murley (CM) scores (14), Visual analogue scale (VAS) (15) and 36-item Short Form Health Survey (SF-36) (16) scores were evaluated.

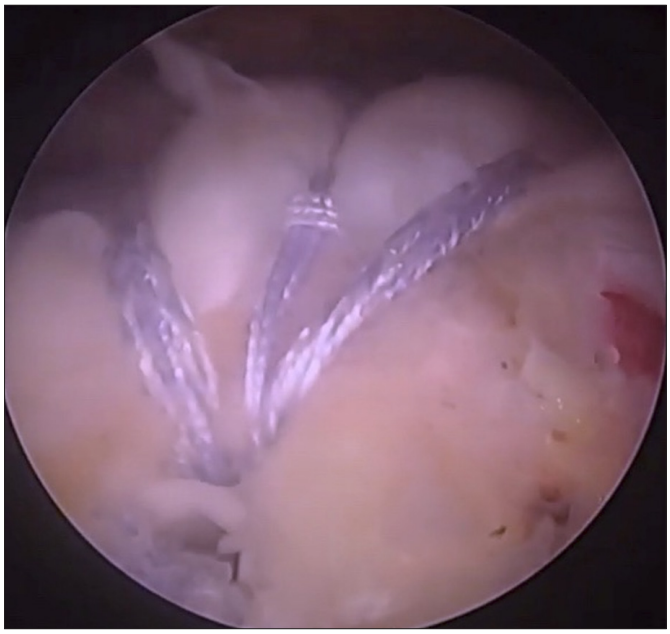

Figure 1. A patient in group 1 who underwent single row rotator cuff repair

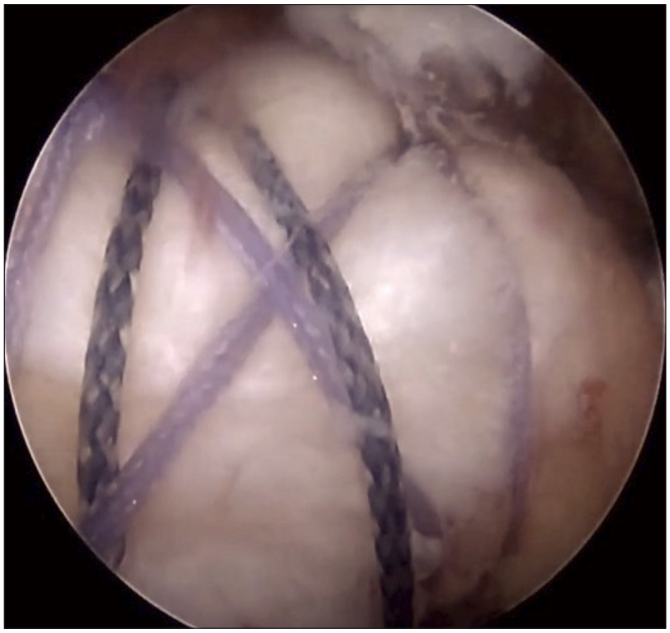

Figure 2. A patient in group 2 who underwent double row rotator cuff repair

Surgical Technique

After performing general anesthesia patients were taken to beach chair position. Standard posterior portal was used to evaluate the glenohumeral joint, supraspinatus, subscapularis and long head of the biceps tendon. Biceps tenotomy was performed in all patients independent from the age. All patients received subacromial decompression, routine acromioplasty was not performed. The suture configuration and repair technique were determined by surgeon's choice.

In patients who received single row repair, one or two metal 5.5mm suture anchors double loaded with number

2 ethibond sutures (Ethicon, Johnson & Johnson, Norwood, MA). The number of sutures determined by tear size. Anchors were inserted to 2 mm lateral to the head of humerus. Each suture were passed the tendon from lateral to the musculotendinious junction to make horizontal matress configration. Samsung medical center (SMC) knot was used to fix tendon over the footprint.

In patients who underwent TOE repair, previously described procedures were completed. Firstly medial row was tied and, the suture limbs were crossed. By this method suture bridges were created across the tendon. One or two footprint anchors were inserted to the lateral aspect of the greater tuberosity for completing the lateral row.

Same postoperative rehabilitation program was prescribed to all patients. Shoulder sling was used for first four weeks, pendulum exercises were started immediately. Active shoulder motion was allowed after four weeks. Streching was contraindicated for three months.

Statistical Analysis

The mean, standard deviation, and percent values were used, as appropriate, to describe the data. The distribution for each measured variable was evaluated for normality using the Kolmogorov–Smirnov test. Categorical variables are summarized as frequency (n) and a percent of the total. Statistical analyses were conducted with $\chi 2$ test test to compare categorical variables (gender, injured side, tear size and re-rupture) and the Student t test to analyze between group differences in preoperative and postoperative ASES Subjective Shoulder Scale, CM, VAS and SF-36 subscales to compare the number of suture anchors used between the 2 groups. Tear size and gender categoric variables on clinical score improvements were analysed by one way ANOVA and Post-Hoc tests. All statistical analyses were performed using the SPSS v24 (SPSS Inc., Armonk, NY) software. P values <0.05 were considered to be statistically significant.

RESULTS

The general patient demographics and disease-specific characteristics of the patients were presented in **Table 1**. When compared to the group 1, group 2 had a significantly lower re-rupture (p=0.001) and surgery time (p=0.043).

Table 2 presents the preoperative and postoperative ASES, CM, VAS, and SF-36 subscale scores at final examination for all patients. Also mean differences of these scores were defined. All values of ASES and CM scores are not significantly different between two groups. Some of SF-36 subscale score improvements after operation are significant; role limitations due to physical health (p=0.041), energy/fatigue (p=0.026), emotional well-being (P=0.017), pain (p=0.010), general health (p=0.037).

Table 3 shows the relationship between gender and clinical score improvements following surgery. Some of the SF-36 subscales were significantly different between genders. Tear size and clinical score improvements were significantly related in terms of CM and physical functioning subscales of SF-36. There was no significant correlation between

Table 1. Demographic and disease-specific characteristics of the patients

Variable	Entire Study Population	Group 1 (n=81)	Group 2 (n=93)	p
Patient number	174 (100)	81 (46.6)	93 (53.4)	
Age, year	62.48±6.43	62.77±5.75	62.22±6.99	0.574
Gender				0.704
Female	110 (63.2)	50 (61.7)	60 (64.5)	
Male	64 (36.8)	31 (38.3)	33 (35.5)	
Injured side				0.863
Right	89 (51.1)	42 (51.9)	47 (50.5)	
Left	85 (48.9)	39 (48.1)	46 (49.5)	
Tear size				0.684
Small	45 (25.9)	22 (27.2)	23 (24.7)	
Medium	94 (54)	41 (50.6)	53 (57)	
Large	35 (20.1)	18 (22.2)	17 (18.3)	
Follow-up time, months	14.08±4.77	14.03±4.89	14.11±4.69	0.911
Re-rupture				0.001
Yes	12 (6.9)	11 (13.6)	1 (1.1)	
No	162 (93.1)	70 (86.4)	92 (98.9)	
Surgery time, minutes, SD	74.82±14.58	72.74±13.72	77.22±15.24	0.043

Abbreviations: statistically significant p values were defined as bold style.

Table 2. Preoperative, postoperative and mean change of clinical scores compared between two groups

Clinical Score	All patients	Group 1 (n=81)	Group 2 (n=93)	p
ASES				
Preoperative	41.85±7.10	40.90±7.91	42.68±6.22	0.098
Postoperative	77.25±12.01	75.35±14.66	78.90±8.85	0.052
Difference	35.39±9.78	34.45±11.40	36.21±8.09	0.238
CM				
Preoperative	40.98±5.22	40.69±5.47	41.24±5.02	0.486
Postoperative	76.75±11.80	75.23±14.03	78.07±9.31	0.113
Difference	35.76±10.64	34.54±12.11	36.82±9.10	0.158
VAS				
Preoperative	6.21±0.89	6.32±0.89	6.08±0.81	0.436
Postoperative	2.03±1.32	2.03±1.46	2.04±1.38	0.313
Difference	4.15±1.65	4.29±1.47	4.03±1.32	0.658
SF-36				
Physical functioning				
Preoperative	59.48±8.83	57.77±8.62	60.96±8.79	0.017
Postoperative	84.19±11.01	82.65±12.27	85.53±9.65	0.085
Difference	24.71±9.65	24.87±10.81	24.56±8.58	0.835
Role limitations due to physical health				
Preoperative	18.41±17.04	18.27±14.40	18.54±19.11	0.915
Postoperative	73.99±15.75	70.06±16.01	77.41±14.77	0.002
Difference	55.57±22.87	51.79±23.38	58.87±22.00	0.041
Role limitations due to emotional problems				
Preoperative	40.48±27.69	36.34±28.10	44.08±26.97	0.066
Postoperative	85.58±18.98	83.70±20.73	87.21±17.26	0.225
Difference	45.09±27.56	47.35±25.81	43.12±29.00	0.314
Energy/fatigue				
Preoperative	29.79±11.16	30.43±11.24	29.24±11.13	0.487
Postoperative	74.45±14.30	71.66±15.85	76.88±12.39	0.016
Difference	44.65±18.93	41.23±20.77	47.63±16.72	0.026
Emotional well-being				
Preoperative	33.37±11.76	32.34±12.65	34.27±10.92	0.281
Postoperative	66.41±17.38	62.32±18.24	69.97±15.85	0.003
Difference	33.03±15.82	29.97±16.00	35.69±15.26	0.017
Social functioning				
Preoperative	28.25±10.61	26.80±10.07	29.52±10.95	0.091
Postoperative	109.05±149.45	94.60±117.63	121.63±172.11	0.235
Difference	43.96±14.28	42.82±14.87	44.95±13.75	0.328
Pain				
Preoperative	23.02±10.09	22.27±10.81	23.67±9.43	0.361
Postoperative	73.63±20.86	69.12±23.40	77.55±17.58	0.007
Difference	50.60±17.99	46.85±19.42	53.88±16.05	0.010
General health				
Preoperative	28.04±13.33	27.28±13.73	28.70±13.01	0.484
Postoperative	75.45±15.99	71.79±18.30	78.65±12.94	0.004
Difference	47.41±17.21	44,50±18.48	49.94±15.69	0.037
Health change				
Preoperative	19.25±16.21	16.66±13.69	21.50±17.90	0.049
Postoperative	79.45±18.37	76.54±20.67	81.98±15.79	0.051
Difference	60.20±23.12	59.87±24.26	60.48±22.21	0.863

ASES American Shoulder and Elbow Surgeons Score, CM Constant Murley score, VAS Visual analogue scale, SF-36 36-item Short Form Health Survey, statistically significant p values were defined as bold style.

Table 3. Comparing results of tear size and gender with clinical scores

Clinical score improvement	Gender			Tear Size			
	Female (n=110)	Male (n=64)	p	Small (n=45)	Medium (n=94)	Large (n=35)	P Post-Hoc Analysis
ASES	34.77±11.17	36.46±6.72	0.272	36.20±7.35	36.13±9.19	32.37±13.20	S-M: 0.999 M-L: 0.126 S-L: 0.191
CM	35.30±11.85	36.54±8.17	0.461	38.48±7.40	36.56±10.04	30.11±13.60	S-M: 0.557 M-L: 0.005 S-L: 0.001
VAS	4.29±1.47	4.03±1.32	0.194	4.39±1.57	4.29±1.12	4.03±1.32	S-M: 0.235 M-L: 0.456 S-L: 0.298
SF-36							
Physical functioning	23.31±9.79	27.10±8.98	0.012	27.33±7.87	25.15±9.54	20.14±10.67	S-M: 0.410 M-L: 0.021 S-L: 0.002
Role limitations due to physical health	51.31±22.73	62.89±21.35	0.001	56.66±17.99	55.00±24.54	55.71±24.31	S-M: 0.916 M-L: 0.987 S-L: 0.982
Role limitations due to emotional problems	42.11±28.54	50.21±25.20	0.061	44.53±29.37	43.03±28.04	51.37±23.38	S-M: 0.951 M-L: 0.280 S-L: 0.514
Energy/fatigue	40.90±19.39	51.09±16.34	0.001	49.00±18.35	44.46±18.29	39.57±20.52	S-M: 0.380 M-L: 0.388 S-L: 0.069
Emotional well-being	32.03±15.91	34.75±15.66	0.277	37.06±14.60	31.36±16.13	32.34±16.04	S-M: 0.115 M-L: 0.947 S-L: 0.379
Social functioning	41.72±14.33	47.81±13.45	0.006	44.37±10.80	43.03±15.15	45.94±15.88	S-M: 0.862 M-L: 0.561 S-L: 0.879
Pain	46.96±18.49	56.87±15.33	< 0.001	55.37±14.44	49.56±18.50	47.28±19.93	S-M: 0.174 M-L: 0.796 S-L: 0.113
General health	44.95±17.65	51.64±15.68	0.013	51.00±12.64	46.64±18.17	44.85±19.30	S-M: 0.344 M-L: 0.858 S-L: 0.254
Health change	56.59±23.13	66.40±21.92	0.007	65.55±22.16	59.57±23.50	55.00±22.52	S-M: 0.325 M-L: 0.574 S-L: 0.106

ASES American Shoulder and Elbow Surgeons Score, CM Constant Murley score, VAS Visual analogue scale, SF-36 36-item Short Form Health Survey, statistically significant p values were defined as bold style.

side, follow-up time and clinical scores.

DISCUSSION

This study reported that, DR repair technique was shown to be significantly associated higher with some of SF-36 (role limitations due to physical health, energy/fatigue, emotional well-being, pain, general health) scores and lower re-rupture rates compared with single row repair technique of an arthroscopic RC repair. ASES and CM scores showed no significant difference between two surgical techniques.

Biomechanical advantages of DR compared with SR have been reported by numeruous studies before (17, 18). Kim et al. (17) reported that cyclic loads following DR repair made lower gap formation compared with SR repair at rotator cuff. The results of another study showed that, more than twice of the native rotator cuff footprint coverage was obtained with DR compared to SR (19). Nevertheless, higher traction strength after DR repair was reported compared to SR repair with cadaveric biomechanical study by Ma et al. (20). These biomechanical advantages appear clinically as re-rupture probability to happen.

Tudisco et al. analysed 20 SR and 20 DR patients with 3 tesla MRI and reported 25% re-rupture in DR patients and 60% re-rupture in SR patients with mean 40 months follow-up. Our results show that SR repaired patients 13.6% had re-rupture and DR patients had 1.1% re-rupture. We did not use MRI for re-rupture investigation, only assessed for symptomatic re-ruptures so our rates were less. Nevertheless, the fact that our results confirmed that we can obtain less re-rupture rates with DR repair method compared with SR method.

Many previous studies compared clinical outcomes of SR and DR repair techniques for ARCR and reported no difference (21-24). Franceschi et al reported that

at the 2-year follow-up of 30 SR and 30 DR patients, University of California, Los Angeles (UCLA) score and range of motion values were not statistically different (23). Sugaya et al (25) followed up 78 patients' mean 35 months and reported no significant difference between SR and DR techniques in terms of ASES and UCLA scores, however they reported better structural outcome of dual-row repairs than the SR technique. However, a majority of these studies were from the patients aged around 65 years. Although, a study included younger patients who are generally <50 years, no superiority of clinical outcomes between SR and DR groups were reported (26). Our results showed no difference between groups in terms of ASES and CM scores. Some of SF-36 subscales were found higher in DR group. Our findings are parallel with previous studies except the quality of life results. This difference may be due to our short follow-up duration. Longer follow-up time may make quality of life scores similar between two groups.

Parallel with previous studies, Saradakis et al. (27) concluded that there is no statistically significant difference between SR and DR in terms of ASES, CM and UCLA clinical scores. Despite that, a significant difference was observed for larger ruptures (>3.0 cm). In another meta-analysis, SR and DR outcomes were similar and larger rupture size worsen the outcomes (10). Senna et al reported similar results with previous studies (1). Our study showed that both groups had similar clinical outcomes, even though only large tears were analysed and no significant differences were detected between both groups except some of SF-36 subscales.

After ARCR, rehabilitation protocols may effect tendon healing. A recent randomized controlled trial reported that, decreased shoulder stiffness and lower re-rupture risk can be obtained with DR repair and accelerated rehabilitation(22). This is particularly relevant for young, active patients who require early return to work and given that young age is a risk factor for postoperative stiffness after rotator cuff repair (28) However, the (add) same postoperative rehabilitation protocol was applied to all patients in our study.

This study showed that, tendon healing and clinical outcomes at short-term appear to be acceptable for both techniques. We found lower re-rupture rates with DR technique and patients with high functional demand may be suitable for DR repair for less complication. The DR repair technique, which is currently known to provide a potentially superior healing environment, can be chosen for younger or active older patients.

The gender distribution between two groups were not statistically different. All clinical scores were also not different in terms of gender. Previous studies promote these findings (29). Grasso et al. reported no difference between groups in terms of gender. Although pain perception can differ between genders, this was not supported by both previous studies and our study.

Limitations are present in our study. First, the mean follow-up time of 14 months is short for the prediction of long-term outcomes. However, given the good and excellent clinical outcomes after both DR repair and SR repair, we think that it is possible to obtain good-excellent long-lasting clinical outcomes with both techniques. Also, lower re-rupture rates following DR technique, we think that good long-lasting tendon integrity can be provided by DR repair. Second, there might be no objective randomization and biases might affect the outcomes.

CONCLUSION

Lower re-rupture rates, and improved quality of life outcomes at short-term follow-up can be obtained by arthroscopic double-row repair. We suggest that the double-row technique can be considered for patients who have medium to large rotator cuff tears, active and high functional demand.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Health Sciences University Kanuni Training and Research Hospital Clinical Researchs Ethics Committee (Date: 23.05.2021, Decision No: 2021/86).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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