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RESEARCH ARTICLE

Comparison of arthroscopic-assisted mini open and all arthroscopic repair methods in small to large size rotator cuff tears

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ABSTRACT

Aim: This study aimed to compare the functional and clinical results of all arthroscopic (AA) and arthroscopic-assisted mini open (AAMO) rotator cuff tear (RCT) repair methods with a minimum 2 years follow-up.

Methods: In this retrospective study, patients who operated with the AA repair method were included in group 1 and patients who operated with AAMO RCT repair method were included in group 2. Between January 2018 and June 2021. All patients were evaluated with shoulder range of motion (ROM), the Disabilities of the Arm, Shoulder and Hand (DASH), Constant Murley Score (CMS) and visual analog scale (VAS) pain score preoperatively and postoperatively. Postoperative evaluation was made on the 3rd, 6th, 12th, and 24th months. In addition, the length of hospital stay, and surgery time were evaluated.

Results: Eighty patients (48 female, 32 male) were included in group 1, who were treated with the AA technique. Sixty-seven patients (28 male, 39 female) were included in group 2, who were treated with the AAMO technique. The average follow-up time was 29,36 ±3,48 months for group 1, 28,12±2,87 months for group 2. No significant difference was detected between group 1 and group 2 for length of hospital stay and follow-up time ($p>0,05$). At the postoperative 3rd-month follow-up measurements, a statistically significant difference was determined between group 1 and group 2 for abduction, flexion measurements, VAS score, and DASH score ($p=0,03$, $p=0,04$, $p=0,02$, $p=0,01$ respectively). At the 24th month postoperative follow-up, statistically no significant difference was determined between groups 1 and 2 in terms of ROM, VAS, and functional scores.

Conclusion: In the early recovery period, AA repair provides better ROM, DASH, and VAS scores. However, in long-term follow-up, no significant difference was detected in AA and AAMO repair in terms of functional results, ROM, and VAS scores.

Keywords: arthroscopic-assisted mini open repair, arthroscopic repair, rotator cuff tear

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INTRODUCTION

Shoulder pain is one of the common reasons for orthopedic outpatient clinic admissions. And one of the most common causes of shoulder pain is a rotator cuff tear (RCT) (1). One in 5 people in the population and one in 3 people with shoulder pain have RCT (2). RCT repair was first described by Codman (3). There are different RCT repair methods, like all arthroscopic repair (AA), arthroscopic-assisted mini open repair (AAMO), and open repair.

In recent decades, the tendency towards all arthroscopic repair has increased (4-6). AA repairs have some advantages like minimal damage of soft tissue, lower postoperative pain, the possibility of treatment of intra-articular lesions, and smaller incisions (7-9). And AA repair methods complication rate is lower than other methods (10). However, bone-tendon fixation is stronger with open procedures (11).

Levy first described AAMO repair technique (12). The advantages of AAMO repair are lower costs, stronger bone-tendon fixation, shorter operating time, and shorter learning curve (13-15). Good results were achieved with AAMO and AA repair in most studies (4-6).

In many reviews and meta-analyses, no difference was determined between the long-term and medium results of these techniques (6,7). However, some studies report that the functional results of AA repair are better in the early recovery period, there is no significant difference in long-term results (16). There is still debate about the choice of these two techniques in RCT repair. This study aimed to compare the functional and clinical results of AA and AAMO repair methods with a minimum 2-year follow-up. Our hypothesis was that the functional and clinical results of AA repair would be better than AAMO repair.

MATERIALS AND METHODS

Approval for the study was granted by the institutional review board of the authors' affiliated institutions (Project number: E1-23-4422, date: 13/12/2023). All the researchers who participated in the study signed the most recent version of the Helsinki Declaration. All patients signed an informed consent form.

In this retrospective study, between January 2018 and June 2021, medical records from our institution were reviewed and patients who underwent RCT repair were identified. RCTs were classified according to the full-thickness tear size using the classification defined by DeOrio and Cofield. Patients who had small to large RCT and underwent AA or AAMO repair were included in our study. Physical examination, magnetic resonance imaging (MRI), and radiography were used to diagnose RCT.

Inclusion criteria:

- Age between 30 and 75 years
- Small to large RCT on preoperative MRI
- Minimum 2 years follow-up

Exclusion criteria:

- Massive RCT
- Shoulder instability
- Slap lesion
- Pseudoparalysis or pseudoparesis
- Rheumatoid arthritis
- Adhesive capsulitis
- Glenohumeral arthritis
- Glenoid or humeral fracture history
- Osteomyelitis or septic arthritis
- Previous surgery on the affected shoulder
- Cognitive disorders

Patients with missing medical records were excluded from the study. And the surgeon of the case decided which surgical technique to use. Patients who underwent AA repair were included in group 1 and patients who underwent AAMO repair were included in group 2.

All patients were operated in the beach-chair position and under general anesthesia. Standard posterior, anterior and lateral arthroscopy portals were used. Firstly, an arthroscopic examination of the shoulder was performed. Intraarticular pathologies were treated appropriately. Then, subacromial space was entered. Radiofrequency and shaver were used for good visualization. Arthroscopic acromioplasty was

performed with a burr in necessary cases. After arthroscopic debridement and acromioplasty, RCT repair was performed with the AA or the AAMO repair technique. For AAMO, a 4 or 5 cm incision was made starting from the anterior border of the acromion. Afterward, RCT repair was performed with all suture anchors and metal suture anchors.

A shoulder-arm sling with abduction support was used for all patients postoperatively. Pendulum exercises were applied in the first week after surgery. After the first week, passive motion exercises were started. Six weeks after surgery, active range of motion (ROM) exercises were started. And six months after surgery, patients returned to sports activities. All patients were given the same rehabilitation program.

All patients were evaluated with shoulder range of motion (ROM), visual analog scale (VAS) pain score, the Disabilities of the Arm, Shoulder and Hand (DASH) and Constant Murley score (CMS) preoperatively and postoperatively. Postoperative evaluation was performed at 3rd, 6th, 12th, and 24th months. In addition, surgery time and the length of hospital stay were evaluated.

Statistical analysis

Statistical data analyses were performed using SPSS 22.0 software (SPSS Inc., Chicago, IL, USA). Categorical variables were compared using the chi-square test. The suitability of continuous variables to normal distribution was examined by calculating skewness and kurtosis values. Continuous variables with normal distribution were compared using the independent samples t-test, and continuous variables with non-normal distribution were compared using the Mann-Whitney U test. Measurements taken before and after the surgery were analyzed using the dependent sample t test. The results were evaluated within 95% confidence intervals, and $P<0.05$ was considered significant.

RESULTS

A hundred and fifty-four patients were included in our study. Two patients were re-operated due to re-rupture. These patients were excluded from the study. Five of the patients' data could not be accessed from the medical record system and they were excluded. Eighty patients (32 male, 48 female) who underwent AA repair were included in group 1. Sixty-seven patients (28 male, 39 female) who underwent AAMO repair were included in group 2. The mean age of the AA group and the AAMO group was 56,39±7,83 and 59,21±8,42 years, respectively. For group 1, 44 right and 36 left shoulders were operated. The operated side was the dominant side for 49 of the group 1. For group 2, 36 right and 31 left shoulders were operated and 38 of them were dominant side. Six patients of group1 and five patients of group 2 were smokers (Table 1).

The average follow-up time was 29,36±3,48 months for the AA group and 28,12±2,87 months for the AAMO group. The mean length of hospital stay was 2,1 days and 2,3 days for the AA group and the AAMO group, respectively. No statistically significant difference was determined between the AA group and the AAMO group for length of hospital stay and follow-up time. (p>0,05) Surgery time was 69,81±18,4 minutes for the AA group and 53,76±14,28 minutes for the AAMO group.

Table 1. Patient characteristics

		Group 1 (n:80)	Group 2 (n:67)	P value
Age (years)		56,39±7,83	59,21±8,42	0,684
Gender	Male	32 (%40)	28 (%41,79)	0,971
	Female	48 (%60)	39 (%58,21)	
Side	Right	44 (%55)	36 (%53,73)	0.952
	Left	36 (%45)	31 (%46,27)	
Dominant side		49 (%61,25)	38 (%56,71)	0.568
Smoker		6 (%7,5)	5 (%7,4)	0,951

Table 2. The mean follow-up time, length of hospital stay and surgery time of the group 1 and group 2			
	Group 1 (n:80)	**Group 2 (n:67)**	**p value**
Follow-up time (months)	29,36±3,48	28,12±2,87	p>0,05
Length of hospital stay (days)	2,1	2,3	p>0,05
Surgery time (minutes)	69,81±18,4	53,76±14,28	p=0,02

Table 3. Preoperative and postoperative shoulder range of motion measurements				
		Group 1	**Group 2**	**p value**
Abduction (degrees)	Preoperative	95±7,47	97±8,65	0,58
	3rd month	130±6,34	112±5,23	**0,03**
	6th month	145±7,22	138±6,83	0,14
	12th month	160±5,32	157±4,71	0,24
	24th month	165±3,41	163±3,28	0,36
Flexion (degrees)	Preoperative	88±8,69	91±7,88	0,62
	3rd month	136±4,33	117±4,56	**0,04**
	6th month	155±6,11	147±5,69	0,28
	12th month	162±4,21	158±5,37	0,84
	24th month	163±2,3	162±3,81	0,45
External rotation (degrees)	Preoperative	39±6,81	41±6,39	0,33
	3rd month	41±5,71	46±4,52	0,25
	6th month	59±4,32	62±5,21	0,61
	12th month	64±5,89	66±3,28	0,30
	24th month	69±3,74	71±2,36	0,41
Internal rotation (degrees)	Preoperative	42±5,56	39±6,23	0,57
	3rd month	51±5,87	54±4,74	0,47
	6th month	64±4,21	63±3,48	0,32
	12th month	71±3,57	68±3,67	0,44
	24th month	74±2,35	71±2,85	0,31

A statistically significant difference was determined between the AA group and the AAMO group. (p=0,02) (Table 2) Biceps tenotomy or tenodesis was performed in patients with biceps tendon pathology.

Preoperative and postoperative shoulder ROM measurements (external and internal rotation, flexion and abduction) were performed. A statistically significant increase was determined between all patients' preoperative and postoperative 24th-month measurements (p<0,05). There was no significant difference between postoperative 24th-month follow-up shoulder ROM of the AA group and the AAMO group. However, in the 3rd month follow-up measurements, a statistically significant difference was observed between the AA group and the AAMO group in abduction and flexion measurements (p=0,03, p=0,04) (Table 3). In group 1, biceps tenotomy was performed in 22 patients, and biceps tenodesis was performed in 4 patients. In group 2, biceps tenotomy was performed in 16 patients and biceps tenodesis was performed in 2 patients. No significant difference was determined between group 1 and group 2 (p>0.05).

Table 4. Preoperative and postoperative VAS and functional scores

		Group 1	Group 2	p value
VAS score	Preoperative	7,2±1,1	7,6±0,9	0,24
	3rd month	3,3±0,6	5,1±0,5	**0,02**
	6th month	2,9±0,8	3,2±0,7	0,61
	12th month	1,6±0,6	1,9±0,5	0,32
	24th month	1,3±0,4	1,3±0,4	0,48
DASH score	Preoperative	56±9,1	54±6,37	0,36
	3rd month	41±6,2	48±4,94	**0,01**
	6th month	38±5,06	39±6,17	0,32
	12th month	33±4,24	32±4,36	0,26
	24th month	29±39	31±3,98	0,29
CMS score	Preoperative	39±3,45	41±2,98	0,67
	3rd month	53±4,56	56±5,39	0,13
	6th month	61±4,82	63±5,68	0,24
	12th month	67±7,28	68±6,74	0,39
	24th month	77±6,37	75±7,49	0,59

VAS: visual analog scale, DASH: the Disabilities of the Arm, Shoulder and Hand, CMS: Constant Murley score.

VAS scores of the AA group and the AAMO group were evaluated. No statistically significant difference was determined between the preoperative and 24th-month follow-up VAS scores of the AA group and the AAMO group (p=0,24, p=0,48). However, for postoperative 3rd month follow-up, there was a statistically significant difference between the VAS score of the AAMO group and the AA group (p=0,02). The VAS score of the AA group was lower. DASH and CMS scores were evaluated for functional outcomes. No statistically significant difference was determined between preoperative and postoperative 24th-month follow-up DASH and CMS scores of the AAMO group and the AA group. Only at postoperative 3rd month follow up, a statistically significant difference was determined between the DASH scores of the AAMO group and the AA group (p=0,01) (Table 4).

DISCUSSION

At the 24th month follow-up, there is no difference between the results of AA and AAMO repair in terms of ROM, DASH, CMS and VAS scores. However, at the 3rd-month follow-up, shoulder abduction and flexion ROM, VAS, and DASH scores are better in the AA group. The length of hospital stay is similar for AA and AAMO techniques. And surgery time is shorter with the AAMO technique.

AA repair is the more frequently preferred RCT repair method today. With the development of arthroscopic techniques and increasing surgical experience, arthroscopic repair is preferred more frequently (17). AAMO repair is an alternative method to AA repair. With the AA method, patients have less pain and better outcomes in early postoperative period (18). Some studies have shown faster rehabilitation, better functional scores, better improvement in VAS score and ROM with the AA method. In the current study, for AA repair, ROM, functional scores and VAS scores are better in early follow-ups.

Many studies have used DASH and CMS to assess functional outcomes (16,18). In our study, while there was no difference in CMS and DASH scores in long term follow-ups, DASH scores were better in the AA repair group in early follow-ups. The better early functional results can be explained by less deltoid muscle damage

and less detachment of muscle fiber from the acromion in the AA repair group (19).

AA repair requires a longer learning curve and higher skill compared to mini open repair. Additionally, the surgery time of AA repair is generally longer. Liu et al. (16) and Cho et al. (20) showed AA repair surgery time was longer than AAMO repair. In our study, the average surgery time for AA repair is longer. Park et al. (21) reported that patients who were treated with AA repair, had fewer scars, shorter hospital stays, less postoperative pain, and earlier rehabilitation. In our study, patients who underwent AA repair had less postoperative pain at 3rd month and scar. However, the length of hospital stay was similar for AA and AAMO repair.

In most of the studies in the literature, no statistically significant difference was determined between the clinical outcomes of AA and AAMO repair. Kang et al. (15) and Köse et al. (22) showed that AA repairs had no superiority over AAMO repair. Zhang et al. (23) showed that no statistically significant difference was determined between the clinical outcomes of the two repair methods. In our study, there was no difference between the clinical outcomes of the two repair methods. However, in his study Zhang et al. (23) also showed that the re-tear rate was higher in AA repairs. In the current study, two of the patients who underwent AA repair developed re-tear.

When the postoperative VAS scores of AA repair and AAMO were compared, in most of the studies, there was no difference after 6 weeks (9). However, Cho et al. (20), showed that postoperative pain was lower on postoperative days 1 and 2. Surgical retraction and split incision of the deltoid may cause postoperative pain in AAMO repair. It can also cause arthrofibrosis. And it may result in decreased muscle strength and difficulty in rehabilitation. In our study, the VAS scores of the patients who underwent AA were lower on the 3rd postoperative month. However, no difference was observed in subsequent controls.

Our study has some limitations. Firstly, the design of the study was retrospective. Secondly, the study groups were not large enough. Thirdly, a standard rehabilitation program was not applied to all patients. Fourthly, some factors, such as single-row or double-row repair, acromioplasty, rehabilitation program, and tear size were not evaluated in our study.

CONCLUSIONS

In the early recovery period, AA repair provides better ROM, DASH, and VAS scores. However, in long-term follow-up, there is no difference between AA and AAMO repair in terms of functional results, ROM, and VAS score.

Ethical approval

This study has been approved by the Ankara Bilkent City Hospital No. 1 Clinical Research Ethics Committee (approval date 13/12/2023, number E1-23-4422). Written informed consent was obtained from the participants.

Author contribution

Concept: EK, BS; Design: EK, BS; Data Collection or Processing: EK; Analysis or Interpretation: EK, BS; Literature Search: EK; Writing: EK. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest.

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