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# Arthroscopic versus Mini-Open Rotator Cuff Repair: Should We Ignore the Mini-Open Surgery?

## Artroskopická vs. otevřená miniinvazivní reparace rotátorové manžety: měli bychom ignorovat miniinvazivní chirurgii?

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## ABSTRACT

PURPOSE OF THE STUDY

To compare the functional and radiological results of the total arthroscopic treatment (TAT) performed due to the rotator cuff (RC) tear problem with the results of the arthroscopically assisted mini-open surgery (AAMOS).

MATERIAL AND METHODS

This study conducted over a two-year period included all had TAT or AAMOS. Patients were included in the study if they had undergone arthroscopic or mini-open rotator cuff repair, with a minimum of 2 years' follow-up. Patients were divided into two groups in terms of the surgical technique performed. Patients who had TAT was included into the group 1 and, AAMOS group 2. Exclusion criteria included other significant intra-articular pathology such as SLAP lesions or glenohumeral arthrosis, previous rotator cuff surgery, massive rotator cuff tears (>5 cm), and neurologic disorders such as brachial plexopathy or suprascapular neuropathy. Every patient underwent magnetic resonance imaging evaluation before surgery and at last follow-up after surgery. Acromion typed of patients were recorded. Patients were questioned for ASES and Constant score.

RESULTS

Fifty-eight shoulders were included in the study. Twenty-eight patients were female and 30 were male. The mean age was 55.63 ± 8.06 years. Both groups had 29 patients per each. Mean follow-up period was 26.26 ± 11.46 months. There was no statistically significant difference between the mean age and gender distribution of the groups ($p > 0.05$). No statistically significant difference in the follow-up period between two groups ($p > 0.05$). No statistically significant difference was found between the postoperative ASES measurements between the two groups ($p > 0.05$). There was no statistically significant difference in postoperative Constant measurements between the two groups ($p > 0.05$). There was no statistically significant difference between the Acromion types between the two groups ($p > 0.05$). No statistically significant difference was found between the both groups in terms of accompanying shoulder pathology and AC joint degeneration ($p > 0.05$). In the postoperative MRIs of the patients, 7 patients in the Group 2 and 6 patients in the Group 1 were found to have recurrent tears. No statistically significant difference was found ($p > 0.05$).

DISCUSSION

When compared their patients who underwent RC repair by AAMOS intervention with those treated with TAT intervention and stated that the results were satisfactory for both groups and close to each other during their 2-year follow-up regardless of the tear diameter. Rotator cuff repairing with TAT is becoming a popular method of shoulder surgery. Initial reports of outcomes with this technique have indicated similar results when compared with open techniques, with less perioperative morbidity. Patients with RC tears treated by TAR, the shoulder range of motion was achieved in a shorter time and the rate of development of fibrous ankylosis was found to be lower. We performed the same configuration for the repair technique that may avoid to differ the results. Additionlay, all patients in study had the same rehabilitation protocol not to differ the results. Our study demonstrated similar results, with no differences noted in clinical outcomes between the TAT and the AAMOS for all scoring scales evaluated. Our experience with TAT notes a steep learning curve for proper technique. Certainly, surgeons may attempt a TAT, knowing that the patient's long-term outcome will not differ if the AAMOS is needed.

CONCLUSIONS

It must be kept in mind that both surgical methods may provide satisfactory results; the decision regarding which method should be used must be based on the skills, experience and technical oppurtunities of the orthopedic surgeon. However, any of the surgical technique is chosen, smilar excellent clinical results can be achieved.

**Key words:** rotator cuff, mini-open surgery, total arthroscopic repair, cuff tear, Constant score, ASES score.

## INTRODUCTION

Rotator cuff (RC) tendon pathologies are among the primary causes of shoulder pain in young and elderly patients (4, 6). Surgical repair of rotator cuff (SRRC) is a procedure commonly applied to eligible patients, which has proven beneficial in relieving pain and function (17, 27).

In recent years, treatment options for RC ruptures changed from open surgery to mini open and fully arthroscopic surgery options. Nevertheless, despite their increasing popularity and reported advantages, arthroscopic and open RC repairs are reported to have similar clinical results (24, 25). Although arthroscopic surgery prolongs the operation time and cost, its advantages such as less morbidity, rapid healing, better imaging, increased soft tissue mobility, patient acceptance of surgery and less pain are reported as advantages over open surgery (4, 13).

Studies report that post-SRRC short-term complication rates from 0.9% to 2.1% (21). However, the available literature regarding the comparison between arthroscopic repair of RC and open technique is limited to single center studies, small patient groups or specific patient populations.

Our hypothesis is to show that total arthroscopic treatment (TAT) for RC tendon tear has similar results compared to the arthroscopically assisted mini-open surgery (AAMOS).

Our study aimed to compare the functional and radiological results of total arthroscopic repair operated due to RC tear problem with the results of arthroscopically assisted mini-open surgery.

## MATERIALS AND METHODS

This retrospective study was conducted at a single institution between 2017 and 2020. This study was conducted with the approval of the Institutional Review Board and was in line with the ethical principles of the Declaration of Helsinki. The reference number for the ethics committee approval was 20/344-67.

This study conducted over a two-year period included all had undergone RC TAT or AAMOS. Patients were included in the study if they had arthroscopic or mini-open rotator cuff repair, with a minimum of 2 years' follow-up. Exclusion criteria included other significant intra-articular pathology such as SLAP lesions or glenohumeral arthrosis, previous rotator cuff surgery, massive rotator cuff tears (>5 cm), and neurologic disorders such as brachial plexopathy or suprascapular neuropathy.

A retrospective review of surgical records was performed, including a detailed medical history, physical examination, and radiographic evaluation. Every patient underwent magnetic resonance imaging evaluation before surgery and at last follow-up after surgery.

Patients were divided into two groups in terms of the surgical technique performed. Patients who had RC TAT were included in group 1 and patients who had AAMOS were included in group 2.

All surgeries were performed by one surgeon using similar surgical techniques within each group. All patients underwent examination under anesthesia followed by a diagnostic glenohumeral and subacromial arthroscopy. All patients then underwent coracoacromial ligament release coupled with an arthroscopic decompression. Arthroscopic decompression was performed using the posterior acromion as a guide for resection, converting acromion morphology to type I postoperatively. No patients in either group underwent distal clavicle resection.

Bone anchors were the primary method of fixation in the groups, averaging 1.5 per a case. In the group 2, the majority of fixations were through bone tunnels. All anchors used were bioabsorbable with permanent sutures. All of the anchors were double loaded with suture, giving 2 points of fixation per anchor. Each anchor was directly visualized implanting the bone and tested for integrity before it was used.

The rehabilitation protocols for the both groups were same. Postoperatively, the patients were maintained in an arm sling and began passive range of motion in the frontal plane, pandulum exercise with isometric exervises immediately after surgery. Active-assisted supine motion was begun at 4 weeks. Resistive exercises started at approximately 3 months.

Acromion typed of patients were recorded. Patients were questioned for ASES and Constant score.

Statistical analyses were performed using SPSS version 14.0. Statistical analysis of the results between the 2 groups was performed using a 2-sample t-test. The primary end-point of this study was the ASES and Constant scoring surveys. A power analysis was performed to determine the ability of the study to detect a significant difference in ASES ans Constant scores between two groups. The minimal clinically important difference (MCID) used for this calculation was 7 for ASES and Constant points. This study had 88% power for detecting an MCID between study groups at a significance level of 0.05.

## RESULTS

A total of 72 patients with 76 treated shoulders met the inclusion criteria, which included surgically proven full-thickness rotator cuff tears. Fourteen patients with 18 shoulders were unavailable for the study: records were lost for 3 patients with 6 shoulders, and 11 patients with 12 shoulders were not included in the study that they did not respond to call or e-mail requests. A total of 58 patients with 58 shoulders were included in the study. Both acute and chronic tears were included.

The study includes a total of 58 cases with 48.3% (n = 28) female and 51.7% (n = 30) male. The average age of all patients is 55.63 ± 8.06 years. 50% (n = 29) of the cases were in the group 1, and 50% (n = 29) in the group 2. While 53.4% (n = 31) of the cases are on the right side, 46.6% (n = 27) are on the left side. The number of the patients who had surgery from their dominant limb was 36 (62%). Follow-up periods range

*Table 1. Demographic changes*

| | | **TAT** (n=29) | **AAMOS** (n=29) | ***p*** |
|---|---|---|---|---|
| **Age (year)** | *Min–Max (Med)* | 39–73 (56) | 40–70 (55) | [a]***0.449*** |
| | *Mean±Ss* | 56.44±8.65 | 54.82±7.49 | |
| **F/U time** | *Min–Max (Med)* | 5.73–35.83 (29) | 7.37–43.03 (31.8) | [b]***0.041**** |
| | *Mean±Ss* | 23.83±9.95 | 28.69±1.49 | |
| **Gender;** *n (%)* | Female | 18 (62.1) | 10 (34.5) | [c]***0.066*** |
| | Male | 11 (37.9) | 19 (65.5) | |
| **Side;** *n (%)* | Right | 16 (55.2) | 15 (51.7) | [c]***1.000*** |
| | Left | 13 (44.8) | 14 (48.3) | |

[a] Student's t-test [b] Mann-Whitney test
[c] Yates' continuity correction test *p < 0.05

*Table 2. ASES evaluation of the groups*

| **ASES** | | **TAT** (n=29) | **AAMOS** (n=29) | ***p*** |
|---|---|---|---|---|
| **Preop** | *Min–Max (Med)* | 22–57 (37) | 11–50 (36) | [a]***0.047**** |
| | *Mean*±Ss | 38.51±9.25 | 33.62±9.08 | |
| **Postop** | *Min–Max (Med)* | 42–100 (90) | 33–100 (86) | [a]***0.494*** |
| | *Mean*±Ss | 86.58±15.01 | 83.89±14.71 | |
| | ***p*** | [d]***0.022**** | [d]***0.006**** | |
| **Preop-postop** | *Min–Max (Med)* | 19–74 (49) | 20–79 (50) | [a]***0.533*** |
| | *Mean*±Ss | 48.06±13.9 | 50.27±12.86 | |

[a] Student's t-test [d] Paired samples t-test *p < 0.05

from 5.73 to 43.03 months, with an average of 26.26 ± 11.46 months (Table 1). The average period of the pre-operative symptom duration was 6±3.6 months. Eight patients had family history for rotator cuff surgery.

There was no statistically significant difference between the mean age and gender distribution of the groups (p > 0.05). No statistically significant difference was found between the follow-up periods of the cases on a group basis (p > 0.05). No statistically significant difference was found between the sides of the cases included in the study on a group basis (p > 0.05) (Table 1).

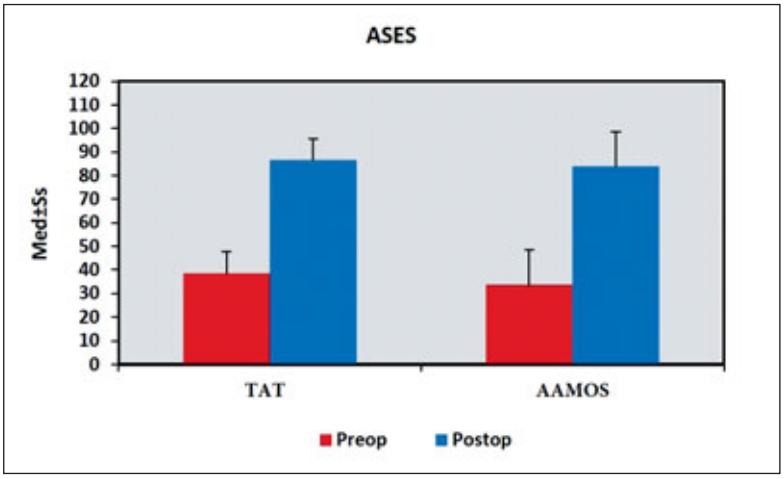


*Fig. 1. ASES comparison of two groups.*

It was found that the preoperative ASES measurements of the group 1 was significantly lower compared to the group 2 (p < 0.05). No statistically significant difference was found between the postoperative ASES measurements between the two groups (p > 0.05). No significant difference was found between the two groups in terms of healing duration of the postoperative period. The mean increase of ASES measurements was 48.06 ± 13.9 in the group 2 after surgery It was found to be statistically significant (p < 0.05). The mean increase of ASES measurements was 50.27 ± 12.86 in the group 1 after the surgery. It was found to be statistically significant (p < 0.05). The change in postoperative ASES measurements compared to the preoperative period showed no statistically significant difference between two groups (p>0.05) (Table 2, Fig. 1).

No statistically significant difference was found in preoperative Constant measurements between two groups (p > 0.05). There was no statistically significant difference in postoperative Constant measurements between two groups (p > 0.05). The mean increase of 34.68 ± 10.61 in the postoperative Constant measurements in the group 2 was found to be statistically significant (p<0.05). The mean increase of 38 ± 12.95 in Constant measurements in the group 1 was also statistically significant (p < 0.05).

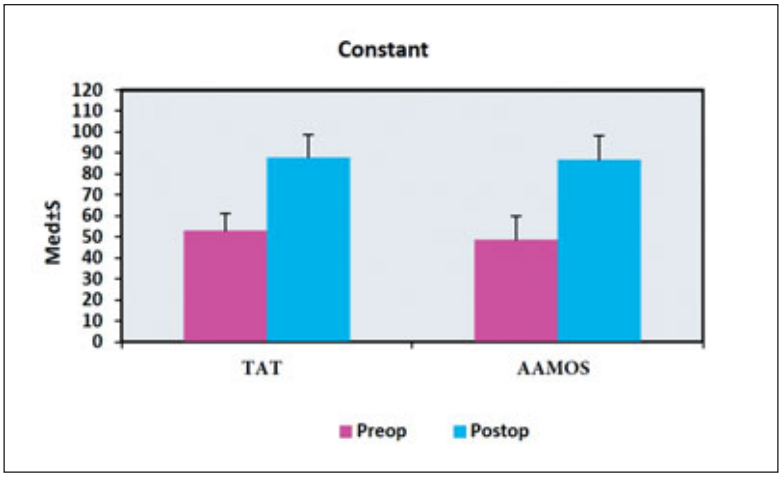


*Fig. 2. Constant comparison of two groups.*

The change in the postoperative ASES measurements compared to the preoperative period showed no statistically significant difference between two groups ($p > 0.05$) (Table 3, Fig. 2).

There was no statistically significant difference between the Acromion types of the cases between two cases ($p > 0.05$). No statistically significant difference was found between the two groups in terms of accompanying shoulder pathology and AC joint degeneration ($p > 0.05$). In the postoperative MRIs of the patients, 7 patients in the group 2 and 6 patients in the group 1 were found to have recurrent tears, and no statistically significant difference was found ($p > 0.05$).

## DISCUSSION

Based on the activity scores, significantly similar clinical healing was seen in two groups compared to the preoperative period of the RC. Although we think that both treatments are useful methods depending to the surgeon's skills, we are also of the opinion that AAMOS may be beneficial in the educational process of young surgeons.

Rotator cuff repairing with TAT is becoming a popular method of shoulder surgery. Initial reports of outcomes with this technique indicated similar results when compared with open techniques, with less perioperative morbidity (2, 9, 10, 24–26). Our study demonstrated similar results, with no differences noted in clinical outcomes between the TAT and the AAMOS for all scoring scales evaluated. Our experience with TAT noted a steep learning curve for proper technique. Certainly, surgeons may attempt a TAT, knowing that the patient's long-term outcome will not differ if the AAMOS is needed. However, when the surgeon has enough skills and experience allow that the TAT may be performed with similar outcomes and less perioperative morbidity.

TAT may have a large number of good and excellent results for long term. TAT can provide outcomes and complication rates equal to those of AAMOS. Furthermore, a significant number of patients regain their shoulder range of motion faster in the first 3 month with the TAT. This is not a significant role in the final range of the motion and overall results, but it may have advantages for the patients in the beginning of the recovery period. This technique may have less perioperative pain, less muscle inhibition, and faster rehabilitation (11).

Various treatment methods can be tried in RC tears depending on the size of the tear. In the case of full-thickness rotator cuff tears, shoulder pain and shoulder dysfunction are often seen to persist with conservative treatment. For surgical repair in patients with full-thickness RC tears, who do not sufficiently respond to conservative treatment; open, mini-open or arthroscopic methods are used (7, 23). According to Codman, who pioneered this work in the past, the gold standard was open surgery (5). Its viability and productivity are also supported by studies of Klepss. Despite the good results, it was thought that the prolonged rehabilitation and morbidity resulted from damage to the deltoid and its repair (1, 3, 8, 16, 18). Since prolonged pain and physical therapy periods were reported by the authors, AAMOS method began to become popular (19). Johnson defined TAT may reduce postoperative pain and shorten the rehabilitation process (14). Due to the developments in arthroscopic techniques, a strong predisposition emerged to apply this procedure. Identified possible advantages

*Table 3. Constant score evaluation of the groups*

| **Constant** | | **TAT**(n=29) | **AAMOS** (n=29) | ***p*** |
|---|---|---|---|---|
| **Preop** | *Min–Max (Med)* | 32–67 (54) | 26–70 (48) | [a]***0.101*** |
| | *Med*±Ss | 53±8.33 | 48.69±11.16 | |
| **Postop** | *Min–Max (Med)* | 57–100 (88) | 43–100 (90) | [a]***0.742*** |
| | *Mean*±Ss | 87.69±11.33 | 86.69±11.65 | |
| | ***p*** | [d]***0.014**** | [d]***0.05**** | |
| **Preop-postop** | *Min–Max (Med)* | 10–54 (35) | 12–61 (38) | [a]***0.292*** |
| | *Mean*±Ss | 34.68±10.61 | 38±12.95 | |

[a] Student's t-test [d] Paired samples t-test *$p < 0.05$

of TAT include minimization of deltoid damage, minimization of axillary nerve damage, and cosmetically smaller wounds (21).

Gartsman reported that after TAT of full-thickness RC tears, the results were satisfactory and equal to the results of open repair. 90% of patients were satisfied with the treatment they received, and 78% showed a good or excellent reduction in pain level, and 90% showed good or excellent shoulder functions (20).

Özbaydar found recurrent tears in 31.8% of the patients in their study evaluating 41 shoulders with full-thickness RC tears, which were TAT repaired. Considering the physical examination and functional scores of the patients, they stated that there was no relationship between recurrent tears and clinical results, and there was no clinically significant difference between patients with intact rotator cuffs and patients with recurrent tears. Several surgeons argued for the positive aspects of AAMOS repair in the treatment of small and medium RC tears (smaller than 3 cm) (25). Stollsteimer et al. compared the results of 891 patients who underwent RC repair and stated that TAT repair was better. There was no difference in the treatment of small (<1 cm), medium (1–3 cm) and large (>3 cm) tears. It was also reported that TAT can be performed in all age groups (7).

The study of Pearsall clinically compared 2 groups of patients who underwent TAT or AAMOS and reported that no statistically significant difference was found between the two groups after surgery, and maintained that AAMOS could be a useful alternative surgical treatment method in small and medium tears (22). In our study we found the similar results regarding to this study. All patients in both groups had satisfactory results. TAT had no significant advantages compared to the AAMOS. The activity scores of the both groups had significantly better results compared to the preoperative period.

According to the results of a prospective study performed by Kasten, the need for NSAIDs was less in the postoperarive first week in patients who underwent TAT repair, while this need was found less in patients who underwent AAMOS after 3 weeks, and there was no significant difference in terms of range of motion, MRI or functional scoring at the end of six months (15). A study clinically compared their patients who underwent RC repair by AAMOS intervention with those treated with TAT intervention and stated that the results were satisfactory for both groups and close to each other during their 2-year follow-up regardless of the tear diameter (12). Some studies reported that patients with RC tears treated by TAT, the shoulder range of motion was achieved in a shorter time and the rate of development of fibrous ankylosis was found to be lower (13, 23).

The most significant limitation of our study was its retrospective nature. Because of this, we were unable to evaluate such parameters as formal strength testing, postoperative pain ratings, and narcotic usage. Our patient number was also less. But our power analysis result reported that our patient number was enough to report. In our study, all patients were operated with the same surgeon that may avoid the bias in the results. We performed the same configuration for the repair technique that may avoid to differ the results. Additionlay, all patients in study had the same rehabilitation protocol not to differ the results.

The main goal of RC surgery repair remains the same, regardless of which surgical technique is prefered. Our study reported that TAT and AAMOS provided similar clinical outcomes and functional improvement. Despite the current study did not evaluate the healing of the RC tendon, we believe that it provides another important part of evidence in support of similar results for the both methods. However, the best indication for TAT versus AAMOS remain controversial, especially with larger RC tendon tears.

## CONCLUSIONS

It must be kept in mind that both surgical methods may provide satisfactory results; the decision regarding which method should be used must be based on the skills, experience and technical oppurtunities of the orthopedic surgeon. However, any of the surgical technique is chosen, smilar excellent clinical results can be achieved.

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