

Arthroscopic rotator cuff repair: evaluation of outcomes and analysis of prognostic factors

Artroskopik rotator manşet onarımı: Sonuçlar ve belirleyici faktörlerin analizi

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Amaç: Rotator manşet tamkat yırtık tanısıyla artroskopik tamir uygulanan hastalardaki sonuçlar ve belirleyici faktörler incelendi.

Çalışma planı: Konservatif tedaviye dirençli 40 hastanın (16 erkek, 24 kadın; ort. yaş 56; dağılım 39-72) 41 omzu değerlendirildi. Ameliyat öncesi yakınmaların süresi ortalama 15 ay (dağılım 2-24 ay) idi. Otuz dört sağ, yedi sol omuz ameliyat edildi. Bunların %80'i baskın taraftı. Hareket açıklıkları açöölçerle, kas güçleri elle ölçüldü. Sonuçlar fizik, radyolojik muayene ve UCLA skalası ile değerlendirildi. Ameliyattan sonra ortalama izlem süresi 37 ay (dağılım 12-61 ay) idi. Belirleyici faktörler olarak, yaş, ameliyat öncesi bulguların süresi, hareket açıklığı, kas gücü, yırtık büyüklüğü, retraksiyonu, tendon kalitesi ve yağlı dejenerasyon değişikliklerinin sonuçlar üzerine etkisi incelendi.

Sonuçlar: UCLA skalasına göre, 29 omuzda (%70.7) tatminkar, beş omuzda (%12.2) orta, yedi omuzda (%17.1) kötü sonuç alındı. Altı omuzda (%14.6) revizyon ameliyatı yapıldı. Öne elevasyon açıklığı ve kas gücü değerlerindeki değişim anlamlı bulunurken ($p<0.05$), dış rotasyon açıklığında anlamlı farklılık oluşmadı ($p>0.05$). Hasta yaşı, yırtık büyüklüğü, retraksiyon, tendon kalitesi ve yağlı dejenerasyon miktarı ile tatminkar olmayan sonuçlar arasındaki ilişki anlamlı bulundu ($p<0.05$). Ameliyat öncesi bulguların süresi, hareket açıklığı ve kas kuvveti ile sonuçlar arasında anlamlı bir ilişki kurulamadı ($p>0.05$).

Çıkarımlar: Sonuçlarımız açık tamir sonuçları kadar başarılı değildir. Artroskopik deneyimimizin artması ve belirleyici faktörlerin hasta seçiminde göz önünde bulundurulmasıyla daha iyi sonuçların elde edilmesi mümkün olabilir.

Anahtar sözcükler: Artroskopi/yöntem; rotator manşet/yaralanma/cerrahi; yırtık/cerrahi; tendon yaralanması/cerrahi.

Objectives: The purpose of this study was to evaluate the results of arthroscopic rotator cuff repair of full-thickness tears and to determine prognostic factors.

Methods: Forty-one shoulders of 40 patients (16 males, 24 females; mean age 56 years; range 39 to 72 years) unresponsive to conservative treatment were evaluated. The mean symptom duration was 15 months (range 2 to 24 months). Involvement was on the right in 34 shoulders, on the left in seven shoulders, 80% being on the dominant side. The range of motion was measured with a goniometer, muscle strength was measured manually. Clinical and functional evaluations were based on physical and radiological examinations, and the UCLA scale. The mean follow-up was 37 months (range 12 to 61 months). Prognostic factors included age, symptom duration, range of motion, muscle strength, tear size, retraction and quality of tendon, and fatty degenerative changes.

Results: According to the UCLA scale, the results were satisfactory in 29 shoulders (70.7%), moderate in five (12.2%), and poor in seven (17.1%). Six shoulders (14.6%) required revision surgery. Postoperative improvements in forward flexion and muscle strength were significant ($p<0.05$), whereas change in external rotation was insignificant ($p>0.05$). Age, tear size, retraction and quality of tendon, and fatty degenerative changes were found to significantly affect unsatisfactory results ($p<0.05$). Preoperative symptom duration, range of motion, and muscle strength were not effective on the results ($p>0.05$).

Conclusion: Our results are not as successful as those obtained from open procedures. The results may be more satisfactory through improving arthroscopic skills and taking prognostic factors into consideration in patient selection.

Key words: Arthroscopy/methods; rotator cuff/injuries/surgery; rupture/surgery; tendon injuries/surgery.

The frequency of rotator cuff tears varies between 5% and 33%.^[1,2,3,4] It has been reported that this condition increases with time and that most of the tears are based on cuff attrition caused by frozen shoulder syndrome.^[5] Discussions related to surgical repair indications still continue.^[6,7,8] In previous studies on pain palliation of the patients through surgical repair and functional recovery, results of 71-100% and 72-82%, respectively, were reported.^[1,2,5,9,10,11,12]

In the literature, the information related to prognostic factors is quite complicated. In young patients, successful results have been reported for small tears and through repair at the early stage.^[6,9,10,11,13] Poor results have been reported for patients with abductor muscle weakness and joint movement restriction.^[1]

The aim of this study is to investigate the results of our rotator cuff repairs and to determine the decisive factors affecting the results.

Patients and method

Out of 56 patients having been operated on between January 2001- December 2004 y the same surgeon, 41 shoulders (72%) of the 40 patients, whose last checks have been performed and whose records are complete, ere evaluated retrospectively. The patients, on whom arthroscopic repairs were made due to full rotator cuff tear and who were followed-up for atleast 1 year, were included in this studt.

During operations, average age was 56 (distribution, 39-72) years. 16 of the patients were male and 24 were female. The duration of the pre-operation complaints were 15 (distribution, 2-24) months. The left shoulder of 33 patients, the right shoulders of 6 patients, and both shoulders of one patient were stiff and 80% of these were the dominant side. One patient had both of his shoulders stiff. Before the surgery, 36 of the shoulders (88%) were painful. The pre-operative trauma histories of 25 shoulders (61%) were taken. The pre-operative examination findings are given in Table 1.

On all the patients, along with the clinical investigation during pre-operation and last-examination checks, shoulder front-back and exit supraspinatus films were taken and radiological examination was made through magnetic resonance imaging (MRI).

The joint movement spans were measured protractor and the muscle movements with hand. In investigating pain, function, movement span, and patient satisfaction in the evaluation of the functional results of the patients and the decisive factors, the core of the University of California, Los Angeles (UCLA) was used.^[11] The perfect (34-35 points) and good (28-33 points) were interpreted as satisfactory, and intermediate (21-27 points) and bad (0-20 points) as unsatisfactory results.

Every was treated with cuff stretching and strengthening exercises and physical therapy for approximately 3 (distribution, 2-6) months and conservative observation through non-steroid anti-inflammatory medications as medical treatment. Movements causing pain were forbidden. For the patients who did not respond to conservative treatment, surgical treatments were used. The primary purpose of the surgical treatment was determined as relieving the pain, and the secondary purpose as recovery of the functions.

In the preoperative MRIs, in order for the supraspinatus muscle to be evaluated qualitatively and quantitatively, cross-sections parallel to glenohumeral joint, predominated by sagittal and oblique T-1. The amount of in-muscle fatty degeneration and atrophy were observed. In accordance with this, the absence of fatty degeneration was classified as phase 0, if it is very small, as phase 1; if it is less than the half of the muscle mass as phase 2; if it is half, as phase 3; and it is more than half, then as phase 4.^[14,15]

Table 1. Preoperative symptoms and findings.

Symptoms	Number	Percentage
Pain		
At rest	16	39.0
At night	20	48.8
Trauma story	25	61.0
Impingement signs	35	85.4
Muscle strength loss	26	63.4
Active Range of Motion (°) (forward elevation)		
<60	3	7.3
60-90	12	29.3
90-120	14	34.2
120-150	6	14.6
>150	6	14.6

Table 2. Preoperative fatty degeneration on MRI/results (UCLA scores).

	Pre-operative		Post-operative		<i>p</i>
	Average	Distribution	Average	Distribution	
Forward elevation (°)	115	45-170	154	45-180	<0.05
External rotation (°)	35	10-55	40	10-80	>0.05
Forward elevation	3	2-5	4+	3-5	<0.05
UCLA score	11	5-16	28.8	13-35	<0.05

Shoulder arthroscopy was performed under general anesthesia and in lounge position. On all the patients, subacromial decompression was performed. In cases where found necessary, acromioclavicular joint levels were equaled. In cases where more than 50% of the biceps tendon was torn, tenotomy or tenodesis was performed.

In order to determine whether or not the cuff tear can be repaired surgically, after the debridement of the tear ends, the mobility of the tendon was investigated using arthroscopic holders. It was evaluated as repairable if the tendon can be easily brought near the joint cartilage without any stress.

The size of the tear was measured using arthroscopic probe at the sagittal plane. The tear sizes were

classified according to the width of the tendons torn from the adhesion points. Small tears were determined as the ones with widths less than 1 cm, intermediate tears with widths between 1-3 cm, large tears with widths between 3-5 cm, and massive tears with widths >5 cm.^[16] The tendon quality was classified as good if the tendon thickness is 4 mm or more; intermediate if it is thinned, but no new tears are formed or the screw is removed when knotted; and bad if these specifications do not exist.^[17] The tendons with good and intermediate quality were assessed as repairable.

For the patients satisfying the reparability criteria, arthroscopic rotator cuff repair was made using hook sutures. According to the tear shape, the side of the tear was moved to the cartilage border putting adjacent sutures in L-shaped tears.

Table 3. Pre and postoperative functional and statistical results.

	UCLA score			
	Excellent	Good	Fair	Poor
Period (months)				
<6	4	13	3	3
6-12	–	1	–	–
>12	2	9	2	4
Age				
≤60	5	15	–	4
>60	1	8	5	3
Forward elevation (°)				
≤90	2	7	2	3
>90	4	16	3	4
Forward elevation muscle strength				
≥4/5	4	8	–	2
≤3/5	2	15	5	5
Fatty degeneration phase				
0	1	1	–	–
1	3	9	2	–
2	2	9	–	1
3	–	2	1	2
4	–	1	3	4

After the operation, the patients were given padded arm slings with belts from the waist and cold was administered intermittently. The pendulum, passive elevation, and outer rotation exercises were started on the first day after the operation. In the fourth week, the arm slings were removed and stretching exercises were started for increasing the movement span; strengthening exercises were started in the eighth week. These exercises were continued for one year. The statistical analyses of the prognostic factors were performed via chi-square test in terms of the variables such as age, the duration of the pre-operation symptoms, movement span, tear size, tendon quality, and the fatty degeneration. For the scoring before and after operation and for the statistical analyses of the variations in the functional values, t-test was used.

Results

After the surgery, average observation duration was 37 (distribution, 12-61) months. The results taken in the physical examinations of the patients

made before and after the surgery are given in Table 2. According to UCLA, satisfactory results were taken on 29 shoulders (71%); intermediate results on five shoulders (12%), and bad results on seven shoulders (17%). The return of the patients to their daily lives was in average in 2 (distribution, 1-6) months.

The findings of the patients were present on the average 14.5 (distribution, 1-120) months before the operation. No significant differences were found between the unsatisfactory results and the satisfactory results on basis of symptom duration. (chi-square=1.61 (6df), $p>0.05$; table 3). Satisfactory results were taken from the nine patients out of 14 patients over the age of 60. A meaningful relation was determined between the advanced patient age and the unsatisfactory results (chi-square= 9.01 (3df), $p<0.05$; table 4). The unsatisfactory results of 14 patients whose forward elevation movement spans are below 90° were at a ratio of 36% and this situation was not statistically meaningful (chi-square=0.49 (3df), $p>0.05$; table 5).

The rate of intermediate and bas results was 33% in 27 patients whose pre-operation forward elevation muscle strengths were 3/5 and below. No meaningful relation was could be formed between the fact that the pre-operation forward elevation muscle strengths were low and the unsatisfactory results (chi-square=5.49 (3df), $p>0.05$; table 6). In standard radiological examination, no pathologies were found in 45% of the shoulders. In the rest, there was at least one finding amongst akromioclavicular arthritis, cystic changes, and sclerosis in tuberculum major.

During operation, 4 small, 24 intermediate, 11 large, and two massive tears were observed. In 26 of the patients, the tear was either transverse linear or crescent-shaped. In the remaining 11 patient, the tear was V-shaped, and one was L-shaped. For the adhesion of the torn tendon to the bone, 1-3 sutured hooks of 5.0 mm were used. Since the biceps tendon tear was more than 50% in five of the patients, biceps tenotomy was performed.

In MRI, fatty degeneration in the rotator cuff was greater than the muscles mass on 8 (19.5%) shoulders ($>50\%$). On one of these shoulders a good UCLA score, on three of them an intermediate, and on four of them ad UCLA scores were obtained. A statistically meaningful relation was obtained between the preoperative fatty degeneration of the

Table 4. Preoperative duration of symptoms/results (UCLA scores)).

	≤ 1 cm	1-3 cm	3-5 cm	> 5 cm
Excellent	–	6	–	–
Good	3	14	6	–
Fair	–	1	2	2
Poor	1	2	1	3

muscle and the unsatisfactory results (chi-square=21.75 (12df), $p<0.05$;table 7). It was observed that size of the rotator cuff tear affected the results of the groups I, II and III meaningfully (chi-square=20.39 (9df), $p<0.05$;table 8).

It was observed that the tear was retracted in 13 patients. In these patients, it was determined that the preoperative torn tendon retraction affected the results meaningfully. (chi-square=21.34 (3 df), $p<0.001$;table 9). On 25 shoulders (61%), it was observed that the rotator cuff tendon quality was good during the operation. The results taken from the patients with good tendon quality during the operation were statistically better than the results taken from the patients with intermediate tendon quality (chi-square= 15.42 (6df), $p<0.05$;table 10).

In the check MRIs, it was observed that the tear recurred on 18 shoulders (44%). According to UCLA, satisfactory results were taken from ten of these patients, intermediate results from two of them, and bad results from six of them. On the six patients from whom bas results were taken, revision surgery was performed. It was observed that the tear repeated itself after the operation in all of the patients on whom revision was performed and, on these patients, open rotator cuff repair was performed. At their last checks, it was observed that 4 patients were satisfied with the surgery. The pain complaint of one patient that necessitated the use of

Table 5. Age / results (UCLA score).

	UCLA score			
	Excellent	Good	Fair	Poor
Retraction				
Present	–	3	4	6
Absent	6	20	1	1
Tendon quality				
Good	6	17	1	1
Fair	–	6	4	6
Poor	–	–	–	–

serious painkillers continued. On one patient, damage was observed instead of deltoid adhesion. This patient was operated for the third time and deltoid muscle repair was done.

Discussion

In spite of the fact that there is no consensus on the effect of the patient age, tear size, retraction, tendon quality, and the amount of fatty degeneration on the rotator cuff tears, these were studied by many authors before.^[1,2,6,7,9,11] However, the indications of the arthroscopic rotator cuff repairs should be discussed and repair techniques continue to develop.

One of the factors that affect the results of rotator cuff repairs is the tear size. Even though the early papers indicate that the tear size does not affect the operation result, recently the relation between the tear size and the operation results are stated frequently.^[18] Demirhan reported that medium and small rotator cuff tears and partial tears were the real application fields of arthroscopic rotator cuff repair and that, through developing techniques and learning stage, they shall be used more frequently in the future.^[19] However, there is no consensus on this issue. Gartsman reports that the tear size is not a decisive factor on the arthroscopic rotator cuff.^[20] Özbaydar and et al. stated that there was no meaningful relation between the tear size and the repair results in their sequence of 22 patients. However, when this study is analyzed, it is seen that the tear is small- and medium-sized in 19/22 patients (86%).^[21] In our study where 41 shoulders of 40 patients were evaluated, 32% of the patients had large-massive tears. It was observed that the size of the rotator cuff tear affected the surgical repair results meaningfully in our patients. One major reason why the tear size affects the repair results may be that, for our patients diagnosed with large tears, generally the tendon quality is also bad. Since the fact that the tear size is measured only on the sagittal plane shall not be sufficient in the evaluation of the results, its relation with the tear retraction and the results has also been investigated. For our patients, a meaningful relation was found between the tear retraction and the unsatisfactory results.

It was reported that the patients with atrophy and fatty degeneration in the rotator cuff muscles were prone to bad results after surgical repairs.^[14] Özbay-

dar and et al. reported that when fatty degeneration is below 50% (22 patients, on the average 47% fatty degeneration), it had no decisive effect on the clinical results.^[21] In our study, the relation between the patients with fatty degeneration over 50% and the unsatisfactory results was investigated, and a statistically meaningful distinction was found.

No meaningful relation was formed between the duration of the preoperative findings and the unsatisfactory results. However, it should be taken in to account while evaluating the patients that there might be difficulties in determining a definite starting date when there is no distinctive trauma.

Complicated reports have been reported related to relation between the surgical results and the ages of the patients.^[18] In our patients, a meaningful relation was determined between the patients over the age of 60 and the unsatisfactory results.

In the literature, the relation between the preoperative shoulder strength and the results was investigated and it was reported that there existed a relation between the decrease in the muscle strength and the bad results. It was stated that the reason for this is the relation between the tear size and the strength decrease.^[18] In our patients, we have not been able to establish a relation between the muscle strength and the unsatisfactory results. However, we believe that the pain determined during the preoperative strength examination affects the results, therefore the relation between the tear size and the strength decrease cannot be observed; and that the muscle strength should be determined using proper anesthetic injection.

When all our patients are considered, satisfactory results were taken from 29 shoulders (71%), intermediate results from five shoulders (12%), and bad results from seven shoulders (17%). On six patients (15%), revision surgery was performed.

In our study, that fact that the unsatisfactory results and revisions were relatively at a large number may be due to the fact that we applied arthroscopic repair also to our patients with large tears, fatty degenerations, and not-good tendon quality. Operating on the patients before the decisive factors prone to unsatisfactory results occur may assist in obtaining better results. However, the discussions continue on whether the surgery should be performed with open techniques or arthroscopically

when patients having bad decisive factors should be operated. It has been reported that, when selecting between mini-open repair and full arthroscopic repair, the expectations of the patient, the mechanical properties of the torn cuff, the experience of the surgeon, and the published results of these techniques should be taken into account.^[19] The arthroscopic repair has advantages for the patient such as smaller incision, probably less pain after the operation, and easier rehabilitation. When the pathoanatomical factors were assessed, it is seen that the most important ones of these are tear size and the tissue quality. It has been reported that Mason-Allen sutures are better in such cases.^[19] Today, the sutures can be made arthroscopically. When the strength of the bone to hold the anchors used in arthroscopic repairs was investigated, it has been observed in many cadaver studies that the strength to hold the anchors is more than that of the bone tunnels.^[22,23] When the literature is studied, there are relatively few papers on the long-term results of arthroscopic rotator cuff repair. However, it has been reported that, via this technique, tears of all sizes can be repaired in all age groups and that the obtained results were equal to or better than the ones obtained from open repair.^[18] It is clear that full arthroscopic repair includes technical difficulties and that there exists a long learning curve. In this study, the results of 41 shoulder of the first 40 patients on whose shoulders we arthroscopically operated and whose final checks were made. Increasing of the experience in this subject and taking into account the prognostic factors often accompanying the unsatisfactory results in selecting the patient on whom arthroscopic repair shall be performed shall contribute to obtaining better results. It is possible to apply arthroscopically the surgical principles used in the open surgery repairs. On patients with large tears and not-good tendon qualities, it may be possible to obtain better results with the methods where a more anatomical repair is provided such as arthroscopically-applied Mason-Allen sutures and/or fixing with double-line anchors.

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