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Research Article / Araştırma Makalesi

Predictability of Re-rupture After Arthroscopic Repair of Medium Rotator Cuff Tears, a Retrospective Study

Medium Rotator Manşet Yırtıklarının Artroskopik Onarımı Sonrası Yeniden Yırtılmanın Öngörülebilirliği, Retrospektif bir Çalışma

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Abstract

Tears of the rotator cuff (RC), which is one of the shoulder joint stabilizers, are among the most important causes of shoulder pathologies. Patients who do not benefit from conservative treatment usually require surgical treatment, and arthroscopic repair is generally preferred. Re-rupture after RC repair is one of the most common complications. The purpose of this study was to examine the relationship of rotator cuff re-rupture (RCR) with preoperative muscle atrophy and to evaluate whether it is possible to predict its occurrence. Eighty-seven patients who underwent arthroscopic repair due to medium (1–3 cm) full-thickness RC tears and were followed for at least 1 year were evaluated. Demographic data of the patients such as age, gender, affected side, and history of diabetes mellitus, hypertension, hyperlipidemia, and smoking were collected. The repair method (singlerow or doublerow) was recorded. The Constant–Murley Shoulder Score and Oxford Shoulder Score were calculated in preoperative and final controls. In the postoperative 1st year, improvements in the RC and re-rupture were evaluated by ultrasonography (USG). Supraspinatus (SS) atrophies were classified using the modified tangent grading method based on the preoperative magnetic resonance imaging (MRI) results of the patients. On USG, 19 (21.8%) patients had re-rupture and 68 (78.2%) had healing. According to the preoperative MRI results of the patients, 48 (55.2%) patients were found to have first-degree SS muscle atrophy, 29 (33.3%) patients second-degree SS muscle atrophy, and 10 (11.5%) patients third-degree SS muscle atrophy. The atrophy degrees of re-ruptured patients on preoperative MRI were higher than those of healed patients($P<0.001$). There was a statistically significant difference in terms of re-rupture according to the preoperative MRI grade of the patients ($P<0.001$). While re-rupture occurred in all of the third-degree cases by MRI, 24.1% of the second-degree patients and 4.2% of the first-degree patients had re-rupture. The highest rate of re-rupture was seen in third-degree cases and the lowest in first-degree cases. Regarding RCR, we can say that SS muscle atrophy is a risk factor, its probability increases as its degree increases, and it can be predicted preoperatively. We believe that these findings will guide practitioners in determining the most appropriate treatment and predicting the prognosis of patients in the postoperative period.

Keywords: Rotator cuff rupture, rotator cuff re-rupture, supraspinatus muscle atrophy

Özet

Omuz eklemi stabilizatörlerinden olan rotator manşet (RM)' in yırtıkları omuz patolojilerinin en önemli nedenlerinden biridir. Konservatif tedaviden fayda göremeyen hastalara genellikle cerrahi tedavi gerekmektedir ve genelde artroskopik tamir tercih edilir. RM onarımı sonrası yeniden yırtılma en sık karşılaşılan komplikasyonlardandır. Çalışmamızın amacı; rotator manşet yeniden yırtılmanın preoperatif kas atrofisi ile olan ilişkisini incelemek ve yeniden yırtılma oluşumunu tahmin etmenin mümkün olup olmadığını değerlendirmektir. Medium (1-3 cm) boyutunda tam kat rotator manşet yırtıkları nedeni ile artroskopik tamir yapılan, en az 1 yıllık takipte olan 87 hasta değerlendirildi. Hastaların yaş, cinsiyet, etkilenen taraf, diabetes mellitus, hipertansiyon, hiperlipidemi ve sigara kullanımı gibi demografik verileri toplandı. Tamir yöntemi (tek sıra ve çift sıra) kaydedildi. Preoperatif ve son kontrolde Constant Murley Shoulder Score ve Oxford Shoulder Score kullanıldı. Postoperatif 1. yılda rotator manşette iyileşme ve yeniden yırtılma açısından Ultrasonografi (USG) ile değerlendirildi. Hastaların, preoperatif çekilen Manyetik Rezonans (MR) görüntülerinden modifiye tanjant derecelendirme yöntemi ile supraspinatus (SS) atrofileri sınıflandırıldı. USG' de 19 (21,8%) hastada yeniden yırtılma, 68 'inde (78,2%) iyileşme saptandı. Hastaların preoperatif çekilen MR' larında; 48 (55,2%) hasta 1. derece, 29 (33,3%) hasta 2. derece ve 10 (11,5%) hasta 3. derece SS kas atrofisi olduğu saptandı. Preoperatif MR' da yeniden yırtılma olanların sağlam olanlara göre dereceleri daha yüksek saptandı ($p<0.001$). Hastaların preoperatif MR derecesine göre yeniden yırtılma açısından istatistiksel olarak anlamlı farklılık vardı ($p<0.001$). MRI 3. derece olanların tamamında tekrar yırtılma yaşanırken 2. derece olanların % 24,1' inde, 1. derece olanların ise % 4,2' sinde yeniden yırtılma oluşmuştur. En çok yırtılma oranı 3. derece, en az 1. derece olgularda görülmüştür. Rotator manşet yeniden yırtılma açısından; SS kas atrofisinin risk faktörü olduğunu, derecesi arttıkça olma ihtimalinin arttığını ve preoperatif tahmin edilebileceğini söyleyebiliriz. Bu durum hastaya en uygun tedavinin belirlenmesinde ve postoperatif dönemde prognozu belirlemek açısından yol gösterici olacağı kanaatindeyiz.

Anahtar Kelimeler: Rotator manşet yırtığı, rotator manşet yeniden yırtığı, supraspinatus kas atrofisi

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1. Introduction

The rotator cuff (RC) consists of four muscles and their tendons that stabilize the humeral head within the shoulder joint and prevent its upward displacement against the deltoid force [1]. Rotator cuff tear (RCT) is one of the most important causes of shoulder problems and its prevalence increases with age [2,3]. Surgical treatment is usually required for patients whose complaints and functional impairments persist despite conservative treatment. Arthroscopic repair has long been considered the standard surgical treatment method for RCT [4,5].

One of the most common complications after RCT arthroscopic repair is rotator cuff re-rupture (RCR), a major concern for shoulder surgeons [6,7]. Studies have reported that patients who developed RCR after RC repair had inferior postoperative clinical outcomes compared to patients who recovered [8–10]. In many studies, the RCR rate varied depending on the patient group selected for the study and the method of evaluation [9–13]. Among the factors that pose a risk for RCR are patient factors such as age and history of smoking, diabetes mellitus (DM), hypertension (HT), and hyperlipidemia (HL); preoperative factors of tissue quality such as supraspinatus (SS) muscle atrophy, fatty degeneration, and tendon mobility; and other factors such as intraoperative surgical technique, postoperative stiffness, and rehabilitation [8,14–19]. Although many risk factors for RCR have been reported, the size of the preoperative tear and fatty infiltration are among the most common and important causes [7,20]. It has been shown that muscle atrophy occurring in the RC is irreversible with surgical repair and is associated with poor outcomes [21,22].

Despite the existence of extensive studies showing that many risk factors are effective for RCR after RCT repair, there is still controversy about whether RCR can be predicted preoperatively. Predicting RCR in the preoperative period would be very useful for both surgeons and patients in determining the surgical treatment method, taking precautions, and determining the postoperative prognosis.

The purpose of our study is to define the RCR rate and associated risk factors after RCT arthroscopic repair by standardizing intraoperative and postoperative factors. In particular, we aim to examine the relation of RCR with muscle atrophy and to evaluate whether it is possible to predict the occurrence of RCR preoperatively. Our hypothesis is that it is possible to predict RCR in patients with RCT in the preoperative period.

2. Materıals and Methods

Study design and participants

We retrospectively reviewed the records of patients who were operated on for RCT at a single center by the same surgeon between July 2015 and September 2019. A total of 281 patients treated surgically with the arthroscopic method were determined.

As per the inclusion criteria of the study, patients were included if they underwent arthroscopic repair due to full-thickness RCT with a size of 1–3 cm (medium) according to the Cofield classification [23] and were followed for at least 1 year. Patients were excluded if they had undergone tenodesis for previous shoulder surgery; if they experienced implant failure or trauma-related RCR, simultaneous adhesive capsulitis, advanced glenohumeral arthritis, or biceps pathology; and if they did not want to be included in the study. Thus, 87 patients who fulfilled the criteria were enrolled in the study.

The study protocol was approved by the Ethics Committee of Ankara City Hospital (Reference Number: E1-21-1482). Written informed consent was obtained from all patients.

Demographic data of the patients such as age, gender, affected side, and history of DM, HT, HL, and smoking were collected. The repair method applied in intraoperative RCT repair was recorded as singlerow (sr) or transosseous equivalent doublerow (dr). The Constant–Murley Shoulder Score (CSS) [24] and the Oxford Shoulder Score (OSS) [25] were calculated to evaluate functional results in the preoperative and final controls.

Imaging plays a vital role in pre- and postoperative evaluation of the shoulder. Ultrasonography (USG) is an excellent modality for evaluating the shoulder postoperatively because of its high spatial resolution and dynamic imaging properties. Although there is a learning curve, USG examination of the shoulder can be focused and is not encumbered by metal anchors or implants. Similar to what is observed in magnetic resonance imaging (MRI), repaired RC tendons may also demonstrate a variable and heterogeneous appearance in USG for years after surgery [26]. All patients were evaluated by USG in terms of healing of the RC and re-rupture in the postoperative 1st year. Dynamic evaluation was performed with a 12L linear probe (9–14 MHz) using a General Electric Healthcare brand Logiq 9 model ultrasound device in our center. SS atrophies were classified using the modified tangent grading method [27] from the first section where the scapula appeared in the Y-shaped sagittal oblique images on preoperative MRIs of all patients. Accordingly, the cases where the SS muscle was above the imaginary line passing through the upper boundaries of the scapular spine and coracoids process were grade 1, those in which it was tangent to the line were grade 2, and those in which it was clearly below the line were determined as grade 3.

Perioperative management

All surgeries were performed in a single center by the same orthopedic surgeon. All patients were situated in the sunbed position with hypotension (systolic blood pressure: 80 to 100 mmHg) under general anesthesia, and a joint pressure pump was operated while maintaining it at about 50 mmHg. Postoperative intravenous analgesic was administered to patients for whom interscalene block could not be performed. Postoperative definitions of tears, repair types, subacromial decompression, additional interventions, intraoperative complications, and operative time were recorded. Anteroposterior lengths of the tears were measured under arthroscopic imaging using a calibrated probe. Considering the tension of the RC, sr or dr repairs were performed.

Postoperative management

Oral analgesic and nonsteroidal antiinflammatory drugs were prescribed at the time of discharge. A shoulder arm sling was used for immobilization for 4 weeks postoperatively.

A similar rehabilitation protocol was applied for all patients after surgery. Pendular exercise was started on the postoperative 1st day. On the 15th day, the sutures were removed and 4-way isometric exercises and passive exercises of up to 90° were started. In addition to isometric exercises, active exercises of up to 90° and passive exercises between 90° and 120° were added at the 1st month controls. After the 6th week, full range of motion active exercise was started. From the 2nd month, strengthening exercises against resistance were started. After 3 months, patients returned to daily activities without any restrictions.

Study measurements

Outcome measurements were collected and scored by one research coordinator. Patient outcome scores were recorded preoperatively and postoperatively.

Constant–Murley Shoulder Score

The CSS is a comprehensive and comparable assessment of shoulder function [24]. This patient- and clinician-completed survey contains four subscales: pain (15 points), activities of daily living (20 points), strength (25 points), and range of motion including forward elevation, external rotation, abduction, and internal rotation of the shoulder (40 points). A higher score represents higher quality of function.

Oxford Shoulder Score

The OSS allows self-assessment of pain and function of the shoulder; it is used in cases of shoulder operations other than stabilization [25]. It contains 12 items: 4 about pain (2 for pain, 2 for interference with pain) and 8 about daily functions. Each item is scored according to 5 Likert-type categories, where 1= no pain/easy to do, 2= mild pain/little difficulty,

3= moderate pain/moderate difficulty, 4= severe pain/extreme difficulty, and 5= unbearable/impossible to do. In the revision study and the online form, the item scoring is from 0 (worst) to 4 (best).

Statistical analysis

Data analyses were performed using SPSS 22.0 for Windows (IBM Corp., Armonk, NY, USA). Whether the distribution of continuous variables was normal or not was determined by Kolmogorov–Smirnov test or Shapiro–Wilk test. The Levene test was used for the evaluation of homogeneity of variances. Continuous data were described as mean ± SD and median (minimum–maximum) for skewed distributions. Categorical data were described as number of cases (%). Differences in statistical analysis among non normally distributed variables between two independent groups were compared by Mann–Whitney U test. Categorical variables were compared using the Pearson chi-square test or Fisher exact test. In addition, the differences in non normally distributed variables between two dependent groups were analyzed by Wilcoxon test. Values of P< 0.05 were accepted as significant in all statistical analysis.

3. Results

The mean age of our patients was 60.97 ± 9.46 years, and 36 were men while 51 were women. The demographic characteristics of the patients are presented in Table 1.

Table 1. Demographic data.

		All cases (n:87)	
Gender	Male	36	(41.4%)
	Female	51	(58.6%)
Age (years)		60.97±9.46	
Average follow-up time (months)		42.99±15.75 44(17–71)	
Side	Right	46	(52.9%)
	Left	41	(47.1%)
Hyperlipidemia		9	(10.3%)
Diabetes mellitus		23	(26.4%)
Hypertension		39	(44.8%)
Smoking		12	(13.8%)

In postoperative USG, 19 (21.8%) patients had RCR and 68 (78.2%) had improvement. When SS atrophies were classified according to the modified tangent grading method based on the preoperative MRI results of the patients, 48 (55.2%) patients were found to have first-degree SS muscle atrophy while 29 (33.3%) patients had second-degree and 10 (11.5%) patients had third-degree. There was a statistically significant difference between the patients with re-rupture and those who were healthy in terms of preoperative MRI grades (P<0.001). Preoperative MRI grades of those with re-rupture were higher than those of healthy patients. There was also a statistically significant difference in RCR according to the preoperative MRI grades of the patients (P<0.001). While all of the third-degree MRI patients experienced re-rupture, 24.1% of the second-degree patients and 4.2% of the first-degree patients did. The highest rate of re-rupture was observed in third-degree cases and the lowest rate was observed in first-degree cases (Table 2).

Table 2. RCR rates according to preoperative MRI (modified tangent) degree.

	Preop. MRI (modified tangent)						P
	1		2		3		
	n	(%)	n	(%)	n	(%)	
Re-rupture	2	(4.2%)	7	(24.1%)	10	100.0%	<0.001
Healthy	46	(95.8%)	22	(75.9%)		-	

Categorical variables are expressed as either frequency or percentage and categorical variables were compared using the Pearson chi-square test or Fisher exact test.

The preoperative mean CSS value of the patients was 36.51 ± 9.50 while the mean postoperative value was 81.13 ± 5.46; postoperative values were thus statistically significantly increased compared to preoperative (P<0.001). The preoperative mean OSS value of the patients was 17.99 ± 4.40, the mean postoperative value was 37.86 ± 3.13, and the postoperative values were statistically significantly increased compared to preoperative (P<0.001). The postoperative CSS and OSS values of the patients with re-rupture were found to be statistically significantly lower than those of patients who recovered (P<0.001) (Table 3).

Table 3. CSS andOSS values.

	Re-rupture		Healthy		P
	$\bar{X}$±SD	Median (min–max)	$\bar{X}$±SD	Median (min–max)	
Preop. CSS	39.95±12.63	35 (28–60)	35.54±8.28	34 (26–64)	0.464
Postop. CSS	73.26±4.58	74 (66–80)	83.32±3.20	83 (72–89)	<0.001
CSS change	33.32±12.5	36 (14–48)	47.78±8.66	8 (21–60)	<0.001
Preop. OSS	19.37±5.47	17(14–28)	17.60±4.02	17 (13–32)	0.466
Postop. OSS	33.68±2.47	34(30–37)	39.03±2.14	39 (32–43)	<0.001
OSS change	14.32±5.38	15 (6–20)	21.43±4.47	21 (7–28)	<0.001

Continuous variables are expressed asmean ± standard deviation (SD) and median (minimum-maximum). Continuous variables were compared with the Mann–Whitney U test.

It was determined that 31 (35.6%) of the patients were treated by dr and 56 (64.4%) by sr RC repair technique. Although the rate of re-rupture was higher in patients who underwent sr repair compared to those who underwent dr, there was no statistically significant difference between the groups in terms of postoperative USG (P> 0.05) (Table 4).

Table 4. Surgery technique.

		Surgery technique				P
		dr (n:31)		sr (n:56)		
		n	(%)	n	(%)	
Postop. USG	Re-rupture	5	16.1%	14	25.0%	0.337
	Healthy	26	83.9%	42	75.0%	

Categorical variables are expressed as either frequency or percentage and categorical variables were compared using the Pearson chi-square test or Fisher exact test.

Although the rates of HL, DM, and HT were higher in patients with re-rupture compared to healthy patients, these differences between the groups did not reach statistical significance (P> 0.05). There was no statistically significant difference between re-rupture or recovery according to smoking habits (P> 0.05). No complications that would require

treatment developed in any of our patients during the postoperative period.

4. Discussion

As the most striking result of our study, SS muscle atrophy was found to be a risk factor for RCR. Accordingly, we can say that RCTs can be predicted in terms of RCR in the preoperative period. We evaluated patients with similarly sized RCTs in this study by standardizing the tear size, which is the most important risk factor for RCR, and thus tried to reduce the confounding effect of this situation.

Jeong et al. [7] stated that RCR can be predicted most effectively when the SS occupation ratio is <43%. Shin et al. [27] concluded that RC repair can positively affect SS muscle atrophy in the postoperative period. Thomazeau et al. [28] reported that SS muscle atrophy on preoperative MRI was a strong predictive factor for RCR. In our study, there was a positive correlation between SS muscle atrophy grade and RCR according to the modified tangent grading method performed on preoperative MRI. As the amount of atrophy increases in the SS muscle, the possibility of RCR increases. We can thus say that a prediction can be made about the possibility of RCR depending on the degree of atrophy in the preoperative SS muscle.

Hein et al. [29] reported that patients who underwent repair with the dr technique had a lower RCR rate than those treated with the sr technique. Millett et al. [19] showed in their meta-analysis that the dr repair technique resulted in a lower RCR rate compared to sr, but they found no difference in clinical outcomes between the two techniques. Zhang et al. [30] showed in their meta-analysis that the dr repair technique had a lower RCR rate than sr, especially in cases of full-thickness RCTs larger than 3 cm. In our study, in contrast to the findings previously reported in the literature, it was observed that there was no statistically significant difference in terms of RCR between patients operated on with dr and sr techniques.

Bishop et al. [31] reported that functional outcomes were significantly worse in patients with RCR. However, a systematic review of 13 studies [32] failed to determine whether functional outcomes of patients with improved RC repairs were permanently superior to those with RCR. Many studies have shown that RCR does not affect pain or clinical function, but some studies have indicated that patients with RCRs have lower clinical function [33–35]. In our study, it was observed that patients with RCR in terms of functional results had lower scores than those who recovered. We think that the lack of consensus on clinical function and pain among those who recovered from RCR in the literature is due to the fact that patient groups and tear sizes were not standardized.

While some authors [36,37] have claimed that DM is associated with RCR, Le et al. [12] reported that there was no significant relationship between them. Jeong et al. [7] also reported that there was no significant relationship between DM, HL, or HT and RCR in their study. In our study, no significant difference was found between patients with and without DM, HT, or HL in terms of RCR.

The limitations of this study were its retrospective nature and the fact that USG is a subjective method of evaluation in terms of RCR. Also, the number of cases could have been higher. The strength of our study was that we standardized the size of rupture, which is the most important risk factor for RCR.

In patients with RCT, we can say that the degree of SS muscle atrophy as examined in preoperative MRI is a risk factor for RCR and RCR can be predicted by evaluating this preoperatively. As the degree of SS muscle atrophy increases, the possibility of RCR increases. Estimating the preoperative RCR will guide practitioners in determining the most appropriate treatment and in predicting the prognosis of patients in the postoperative period.

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