SHOULDER

A comparison of early versus delayed repair of traumatic rotator cuff tears

**Michael E. Hantes · Georgios K. Karidakis ·
Mariana Vlychou · Sokratis Varitimidis ·
Zoe Dailiana · Konstantinos N. Malizos**

Abstract

Purpose The purpose of this study was to compare the clinical and magnetic resonance imaging (MRI) results between early and delayed operative treatment in patients with traumatic rotator cuff tears (RCT).

Methods Thirty-five patients with a traumatic RCT who have been treated surgically during a 4-year period were included in the study. The results of early versus delayed repair of traumatic rotator RCT were assessed using the Constant and UCLA scores. In addition, all patients underwent a postoperative MRI to evaluate repair integrity. Early repair (within 3 weeks) was performed in 15 patients (group I) and delayed repair (after 3 weeks) in the rest 20 patients (group II). The time interval between injury and operation was 12 and 131 days on average for group I and II, respectively.

Results Follow-up time was 34 and 38 months for group I and II, respectively. Postoperatively, the UCLA score was 31 and 26 ($P < 0.05$) for group I and II, respectively. The Constant score was 82 and 70 ($P < 0.05$) for group I and II, respectively. Range of motion was significantly better in group I. According to MRI, 5 patients (33%) in the group I and 7 patients (35%) in the group II had a retear.

Conclusions Early repair of a traumatic RCT provides better results in terms of shoulder function in comparison with a delayed repair. A delayed diagnosis of a traumatic RCT leads to difficulties in surgery and less good results.

Level of evidence Level III, therapeutic, retrospective, comparative study.

Keywords Traumatic rotator cuff tear · Early repair · Delayed repair · Shoulder function

Introduction

Trauma of the shoulder girdle frequently causes traumatic rotator cuff tear (RCT), and the diagnosis may often be missed on the first clinical examination. In a recent prospective study, a high incidence (above 50%) of RCT was found in patients over 50 years after trauma of the shoulder girdle [21]. However, many of these patients in the absence of a fracture around the shoulder are often discharged from the emergency department without a correct diagnosis [21]. Therefore, diagnosis of an acute RCT after trauma is often missed and treatment is delayed. However, a delayed repair (more than 3 weeks) of a traumatic RCT can lead to a poor outcome, according to Bassett and Cofield [2].

The inferior clinical results that have been reported after delayed treatment of traumatic RCT are probably due to the fact that the tendons lose their elasticity and the tension of the repair increased significantly. It is known that increased tension is related to decreased viscoelastic properties of the tendons and inferior rotator cuff healing [6, 8]. Because of the direct trauma to the shoulder, these tears are usually large or massive (involvement of two or even three tendons) and reattachment of the tendons when surgery is delayed is more difficult [9, 17]. According to

M. E. Hantes (✉) · G. K. Karidakis · S. Varitimidis ·
Z. Dailiana · K. N. Malizos
The Department of Orthopaedic Surgery, University Hospital of Larissa, School of Health Sciences, University of Thessalia, Mezourlo, 41110 Larissa, Greece
e-mail: hantesmi@otenet.gr

M. Vlychou
Department of Radiology, University Hospital of Larissa, School of Health Sciences, University of Thessalia, Larissa, Greece

many studies, early repair of traumatic RCT is associated with a good outcome [4, 10, 13, 17, 22]. However, to the best of our knowledge, only one study, which directly compares the results between patients with early and delayed treatment in patients with traumatic RCT, has been published [2].

Therefore, the purpose of this study was to analyze and compare the clinical and magnetic resonance imaging (MRI) results between early and delayed operative treatment in patients with traumatic RCT in a consecutive series of patients. The hypothesis was that early surgical intervention (within 3 weeks) would provide superior clinical results in comparison with a delayed repair (more than 3 weeks).

Materials and methods

From 2003 to 2007, 223 patients with RCT were treated surgically in our department. From these, 39 had a traumatic RCT. Diagnosis of a traumatic RCT was based on the recommendations of the German Association of Shoulder and Elbow Surgery [16]. These criteria included no pre-existing shoulder pain or malfunction, complete, sudden loss of shoulder function, sharp trauma-related pain with correlated dead arm sign in combination with an adequate trauma mechanism such as passive forced external or internal rotation with abducted or adducted arm, passive ventral, medial or caudal traction, axial compression in cranioventral or ventromedial direction, and the combination of traumatic shoulder dislocation. In the contrary, history of chronic shoulder pain or pain with onset irrelevant to the traumatic incident, pre-existing shoulder malfunction, acromioclavicular joint arthritis, and acromion osteophytes were criteria of non-traumatic RC tear, and these patients were excluded form the study. Patients were operated under general anesthesia using a mini-open or an arthroscopic technique by two surgeons. One surgeon used exclusively an arthroscopic approach and the other surgeon the mini-open technique. However, both surgeons used similar techniques and repair was performed in a single-row fashion with suture anchors. Tear size was classified according to Post et al. [20] as follows: small (<1 cm), medium (1–3 cm), large (3–5 cm), and massive (greater than 5 cm).

The diagnosis of the RCT was confirmed preoperatively with MRI. In addition, a postoperative MRI using a standardized protocol of their operated shoulder at least 6 months after the index operation was necessary for participation in the study. Unfortunately, most of the patients (30 of 35) had an MRI examination performed elsewhere, and therefore, a direct comparison between preoperative and postoperative MRI was not possible. All patients were

Table 1 Patient data

Variable	Group A (early repair)	Group B (delayed repair)	P value
Number of patients	15	20	
Mean age (years)	54.2 (28–68)	56.1 (33–70)	NS
Sex			
Male	9	12	NS
Female	6	8	NS
Affected side			
Right	11	13	
Left	4	7	
Dominance			
Dominant arm	11	12	
Non-dominant arm	4	8	
Type of injury			
Fall on the shoulder/hand	11	12	NS
Shoulder dislocation	3	5	NS
Motor vehicle accident	1	3	NS
Preoperative score points			
Constant	39 (17–40)	40 (19–42)	NS
UCLA	10 (6–13)	12 (7–16)	NS

evaluated preoperatively as well as postoperatively with the Constant and Murley score [5] and the UCLA shoulder rating scale [1].

Based on the time interval between injury and operation, patients were divided into two study groups. Group I (early repair group) included patients who were operated within 3 weeks after their injury, and group II (delayed repair group) included patients who were operated later than 3 weeks after their injury. Thirty-nine consecutive shoulders in 39 patients, who met the inclusion criteria, were included in this study. However, 4 of them were not included in the study because they refused to undergo an MRI postoperatively. Group I consisted of 15 patients, and group B consisted of 20 patients. Comparison of the data showed that the two groups were well matched for age, sex, and type of trauma (Table 1).

Both groups had the same rehabilitation protocol, including an abduction pillow at 45° for 6 weeks to protect the repair. Passive range of motion was started 7–10 days after surgery, and active motion was permitted as tolerated 10–12 weeks postoperatively. Strengthening of the joint was then continued for the next 3 months.

MRI protocol

All patients included in our study underwent an MRI postoperatively. A postoperative interval of at least 6 months before follow-up imaging was accepted as the optimum in order to evaluate the prevalence of rerupture

[24]. All postoperative MR scans were performed in a high-field 3.0 TMRI scanner (Signa HDxt, GE, Healthcare) by using a dedicated shoulder coil. No patient underwent MR arthrography since suture anchors made of titanium, as applied in rotator cuff repair, usually produce only minor artifacts, which do not substantially affect depiction of adjacent anatomic structure on conventional MR imaging [23, 25]. The criteria used to diagnose a rotator cuff tear were derived from the literature [19] and included the identification of focal fluid signal intensity in the tendon, the presence of a full thickness defect, or a complete non-visualization of the tendon on T2-weighted images with acknowledgment that in postoperative patients, fluid normally may track into the subdeltoid and subacromial bursae.

All MRI scans were assessed twice by a musculoskeletal radiologist with 5 years experience in a blinded fashion regarding the clinical performance of each patient.

Statistical analysis

Statistical analysis included the Wilcoxon signed rank test for non-parametric data and a two tailed t test to determine significant differences between the two groups for the Constant and UCLA scores. Pearson correlation coefficients and the coefficients of variation were used to determine the intra-observer reproducibility of MRI assessment.

Results

The time interval between injury and operation was 12 days on average (3–20) for the early repair group and 131 days on average (45–303) for the delayed repair group. Follow-up time was 34 (26–62) and 38 (31–70) months for the early and the delayed repair group, respectively. Seven patients (46.6%) in group I (early repair group) and 9 patients (45%) in group II (delayed repair group) had a large tear (NS), while 7 patients (46.6%) in group I and 8 patients (40%) in group II had a massive tear (NS). Finally, one patient (6.6%) in group I and three patients (15%) in group II had a medium tear (NS). Therefore, the distribution of tear size was comparable between the two groups

since no statistically significant differences were detected. Seven patients (46.6%) in group I and 8 patients (40%) in group II were treated arthroscopically (NS), while 8 patients (53.3%) in group I and 12 patients (60%) in group II were treated with the mini-open technique (NS). Therefore, the method of treatment (arthroscopic or mini-open) that patients received was comparable between the two groups.

The Constant score and the UCLA shoulder rating scale improved significantly after rotator cuff repair in both groups. In group I, the median Constant score improved from 39 (17–40) preoperatively to 82 (54–93) postoperatively ($P < 0.001$) and the UCLA score improved from 10 (6–13) preoperatively to 31 (23–33) postoperatively ($P < 0.001$). Similarly, in group II, the mean Constant score improved from 40 (19–42) preoperatively to 70 (36–89) postoperatively ($P < 0.001$) and the UCLA score improved from 12 (7–16) preoperatively to 26 (18–32) postoperatively ($P < 0.001$). Comparison between the two groups revealed that both the Constant and the UCLA scores were significantly higher in the acute repair group ($P < 0.05$). Patients in group I had significantly better motion (shoulder flexion and abduction), better shoulder function, and less restrictions in their activities. However, pain relief and strength recovery were satisfactory in both groups, and no significant differences were found for these parameters.

The mean follow-up period from the date of surgery to the MRI study was 31.5 months (range 21–56). A complete healing of the rotator cuff was observed in 10 of 15 patients (66.6%) in the early repair group and in 13 of 20 patients (65%) in the delayed repair group according to MRI, and this difference was not statistically significant. Finally, the intra-observer variability for measurements was excellent, and the intra-class correlation coefficient was 0.96 with a confidence interval of 0.90–0.98. Interestingly, in the early repair group, no significant differences were found between patients with an intact rotator cuff and patients with a retear. However, in the delayed repair group, both the Constant and the UCLA scores were significantly higher for the patients with an intact repair (Table 2). Six of seven patients with a retear of the rotator cuff in the delayed repair group had a fair or poor result according to both the Constant and the UCLA scores.

Table 2 Comparisons of the constant and the UCLA scores between patients with an intact and a retear of the rotator cuff

	Acute repair group			Delayed repair group		
	Intact	Retear	P value	Intact	Retear	P value
Constant score	83 (58–93)	81 (54–90)	NS	76 (44–89)	61 (36–82)	0.0027
UCLA score	32 (27–34)	31 (23–33)	NS	27 (20–30)	22 (18–27)	0.0041

Discussion

The most important finding of the present study is that early surgical repair of traumatic RCT provides a significant better outcome in comparison with a delayed repair. Both the Constant and the UCLA scores were significantly higher in the acute repair group. More specifically, our results indicated that patients with an early repair had better shoulder motion and function and less restrictions in their activities.

According to some studies, the incidence of traumatic RCT is very low [2, 13]. In the series of Bassett and Cofield [2], only 12 among 510 (2.3%) cases of RCT were classified as acute tears, while in the series of Lähteenmäki et al. [13], 29 of 548 (5.3%) lesions fulfilled the criteria of traumatic RCT. In the present study, 39 of 223 (17.4%) patients with RCT who were treated surgically were classified as traumatic tears. Similarly, Ide et al. [10] reported a 17.7% rate of traumatic RCT in their patients. The higher rate of traumatic RCT in this study is probably due to the increased attention to shoulder trauma in the emergency department. We agree with Sørensen et al. [21] that a detailed history and a proper clinical examination improve the early diagnosis of traumatic rotator cuff tears. These authors found a high incidence (more than 50%) of RCT in patients over 50 years after trauma to the shoulder girdle.

The timing of surgical repair for traumatic RCT has been evaluated by Basset and Cofield [2] many years ago. In their series, 37 patients underwent a surgical repair after traumatic RCT within 3 weeks of injury (group I), between 3 and 6 weeks of injury (group II), and between 6 and 12 weeks of injury (group III). According to their results, early surgical repair (within 3 weeks of injury) affords the best opportunity for maximal recovery of shoulder function. They reported that pain relief was satisfactory regardless of the timing of surgical repair but function and range of motion of the shoulder was better if the repair was done within 3 weeks of injury. Their findings are in accordance with our results since we found that patients in the early repair group had significantly better motion and function of the shoulder and less restrictions in their activities, but pain relief was satisfactory in both groups. Lähteenmäki et al. [13] evaluated the results of early operative treatment (within 3 weeks) of traumatic RCT in 26 patients, and they reported excellent and good results in 92% of their study population, according to the UCLA score. Our study confirms these results since we found a 87% rate of excellent and good results in the acute repair group. However, their study did not include patients with a delayed repair, like our study, and therefore, comparison for the results of a delayed repair cannot be made. Similarly, other authors concluded that early surgical repair of a traumatic RCT is associated with a superior outcome

although they did not specify which is the time limit for an early surgical repair [4, 10, 13, 17, 22]. Gerber et al. [7] proposed a 4-month period between injury and repair as the upper threshold to achieve a minimum 40-point improvement in the Constant score. This is in accordance with our findings, since the time interval between injury and operation patients in the delayed repair group was more than 4 months (mean 131 days) and there was an improvement in the Constant score of only 30 points. Although it is not documented in this study, we believe that a delay in treatment leads to less satisfactory results because of fatty degeneration and muscle atrophy. In addition, the tendons lose their elasticity after a long period between the initial trauma and surgery and this leads to an increased tension of the repair, which impairs the results of surgery.

A high incidence (88.5%) of massive and large tears was found in the present study. Bassett and Cofield [2] and Lähteenmäki et al. [13] reported a 81 and 77% rate of massive and large tears, respectively, in their series. We believe that the high rate of large and massive tears in traumatic RCT reflects the fact that at the moment of shoulder injury (in the absence of a fracture around the shoulder), a high amount of direct or indirect forces are transmitted to the humeral head, which results in an avulsion and retraction of the rotator cuff tendons.

According to MRI results, a retear of the rotator cuff was present in 33.3% and 35% in the early and delayed repair group, respectively. The presence of retear was associated with a fair result in the delayed repair group, while this was not true for the early repair group. It seems that this partial repair of the rotator cuff is less functional in the delayed repair group probably because of the inelasticity of the tendons and the increased tension of the repair in the delayed repair group. Our results are in accordance with other MRI-based reports after open or arthroscopic rotator cuff repairs [3, 11, 12, 14, 15, 18]. Liem et al. [15] reported a 31% and 36% retear rate after arthroscopic and open repair, respectively. Similarly, Klepps et al. [11] found a 38% rerupture rate after open repair, while Yoo et al. [24] reported a 45% retear after arthroscopic repair of large to massive tears.

Limitations of our study include its retrospective nature and the fact that patients in this study were treated by two surgeons, utilizing a mini-open and an arthroscopic technique. Ideally, all patients should receive the same type of treatment. However, the method of treatment (arthroscopic or mini-open) that patients received was similar between the two groups and both surgeons used similar techniques for tissue mobilization and cuff repair. In addition, our study samples are small (because traumatic RCT are relatively rare injuries) and there were perhaps correlations between certain variables that we were unable to detect, and our results should be interpreted within the context of

this limitation. Finally, only cuff integrity and not the role of muscle atrophy and fatty degeneration (which may influence our results) was evaluated by MRI scans since the vast majority of the preoperative MRI studies were not performed in our institution.

Conclusions

Traumatic RCT should be managed early (within 3 weeks) since the functional result of the shoulder according to both the Constant and the UCLA scores is superior in comparison with a delayed repair. In addition, after an early repair, the presence on MRI of a retear does not negatively influence the clinical result, at least in a short-term follow-up.

References

1. Amstutz HC, Sew Hoy AL, Clarke IC (1981) UCLA anatomic total shoulder arthroplasty. Clin Orthop Rel Res 155:7–20
2. Basset RW, Cofield RH (1983) Acute tears of the rotator cuff. The timing of surgical repair. Clin Orthop Rel Res 175:18–24
3. Boileau P, Brassart N, Watkinson DJ, Carles M, Hatzidakis AM, Krishnan SG (2005) Arthroscopic repair of full-thickness tears of the supraspinatus: does the tendon really heal? J Bone Joint Surg Am 87:1229–1240
4. Braune C, von Eisenhart-Rothe R, Welsch F, Teufel M, Jaeger A (2003) Mid-term results and quantitative comparison of postoperative shoulder function in traumatic and non-traumatic rotator cuff tears. Arch Orthop Trauma Surg 123:419–424
5. Constant CR, Murley AHG (1987) A clinical method of functional assessment of the shoulder. Clin Orthop Rel Res 214:160–164
6. Galatz LM, Rothermich SY, Zaeqel M, Silva MJ, Havlioglu N, Thomopoulos S (2005) Delayed repair of tendon to bone injuries leads to decreased biomechanical properties and bone loss. J Orthop Res 23:1441–1447
7. Gerber C, Hersche O, Farron A (1996) Isolated rupture of the subscapularis tendon. J Bone Joint Surg Am 78:1015–1023
8. Gimbel JA, Van Kleunen JP, Lake SP, Williams GR, Soslowsky LJ (2007) The role of repair tension on tendon to bone healing in an animal model of chronic rotator cuff tears. J Biomech 40:561–568
9. Green A (2003) Chronic massive rotator cuff tears: evaluation and management. JAAOS 11:321–331
10. Ide J, Tokiyoshi A, Hirose J, Mizuta H (2007) Arthroscopic repair of traumatic combined rotator cuff tears involving the subscapularis tendon. J Bone Joint Surg Am 89:2378–2388
11. Klepps S, Bishop J, Lin J (2004) Prospective evaluation of the effect of rotator cuff integrity on the outcome of open rotator cuff repairs. Am J Sports Med 32:1716–1722
12. Lafosse L, Brozska R, Toussaint B, Gobezie R (2007) The outcome ans structural integrity of arthroscopic rotator cuff repair with use of the double-row suture anchor technique. J Bone Joint Surg Am 89:1533–1541
13. Lähteenmäki HE, Virolainen P, Hiltunen A, Heikkilä J, Nelimarkka OI (2006) Results of early operative treatment of rotator cuff tears with acute symptoms. J Should Elb Surg 15:148–153
14. Lichtenberg S, Liem D, Magosch P, Habermeyer P (2006) Influence of tendon healing after arthroscopic rotator cuff repair on clinical outcome using single-row Mason-Allen suture technique: a prospective, MRI controlled study. Knee Surg Sports Traumatol Arthrosc 14:1200–1206
15. Liem D, Bartl C, Lichtenberg S, Magosch P, Habermeyer P (2007) Clinical outcome and tendon integrity of arthroscopic versus mini-open supraspinatus tenson repair: a magnetic resonance imaging controlled matched-pair analysis. Arthroscopy 23:514–521
16. Loew M, Habermeyer P, Wiedmann E, Rickert M, Gohlke F (2000) Recommendations for diagnosis and legal assessment of traumatic rotator cuff tears. Unfallchirurgv 103:417–426
17. Namdari S, Frank Henn R III, Green A (2008) Traumatic anterosuperior rotator cuff tears: the outcome of open surgical repair. J Bone Joint Surg Am 90:1906–1913
18. Nich C, Muetschler C, Vandenbussche E, Augereau B (2009) Long-term clinical and MRI results of open repair of the supraspinatus tendon. Clin Orthop 467:2613–2622
19. Owen RS, Iannoti JP, Kneeland JB, Dalinka MK, Deren JA, Oleaga L (1993) Shoulder after surgery: MR imaging with surgical validation. Radiology 186:443–447
20. Post M, Silver R, Singh M (1983) Rotator cuff tear. Diagnosis and treatment. Clin Orthop Relat Res 173:78–91
21. Sørensen AK, Bak K, Krarup AL, Thune CH, Nygaard M, Jørgensen U, Sloth C, Torp-Pedersen S (2007) Acute rotator cuff tear: do we miss the early diagnosis? A prospective study showing a high incidence of rotator cuff tears after shoulder trauma. J Should Elbow Surg 16:174–180
22. Warner JJ, Higgins L, Parsons IM 4th, Dowdy P (2001) Diagnosis and treatment of anterosuperior cuff tears. J Should Elbow Surg 10:37–46
23. Woertlet K (2007) Mutlimodality imaging of the postoperative shoulder. Eur Radiol 17:3038–3055
24. Yoo CJ, Ahn JH, Koh KH, Lim KS (2009) Rotator cuff integrity after arthroscopic repair for large tears with less than optimal footprint coverage. Arthroscopy 25:1093–1100
25. Zanetti M, Hodler J (2006) MR imaging of the shoulder after surgery. Radiol Clin N Am 44:537–551