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ORIGINAL RESEARCH

Assessment of the outcomes following the repair of traumatic and non-traumatic rotator cuff injuries at varying time points: A comparative study

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ABSTRACT

Aim: The aim of the present study was to compare differences in outcomes following the repair of traumatic and non-traumatic rotator cuff injuries at varying time points.

Methods: This retrospective study enrolled patients attending to the Department of Orthopaedics. It was approved by our Institutional Review Board, and the requirement for informed consent was waived by the committee owing to the retrospective nature of the study. Among the 112 rotator cuff injury patients whose charts were reviewed, 100 met the inclusion criteria.

Results: Traumatic RCI patients had 27 early and 23 delayed repairs. Early repair was performed on 22 non-traumatic RCI patients and delayed repair on 33. In the trauma and non-trauma groups, the early repair and delayed repair subgroups had similar tendon involvement. Preoperative VAS, ASES, Constant, and UCLA scores were similar for early and delayed trauma healing. Preoperative VAS, ASES, Constant, and UCLA scores were similar for early and delayed repair patients in the non-trauma group.

Conclusion: Early treatment of traumatic rotator cuff injuries improved range of motion, discomfort, and postoperative re-tear compared to delayed repair. Thus, severe rotator cuff injuries are best treated with early arthroscopic surgery. However, early repair did not improve postoperative joint function and morbidity for non-traumatic rotator cuff injuries.

Key words: Outcomes, repair, traumatic and non-traumatic rotator cuff injuries

INTRODUCTION

Rotator cuff tears that generate symptoms are a frequent source of shoulder pain and impairment, and can generally be categorised as either acute or degenerative. Traumatic tears typically happen in younger individuals following a fall or injury to an arm that is moved away from the body and rotated outwards. On the other hand, chronic or degenerative tears (which are not caused by trauma) are believed to develop partly due to age-related deterioration of the tendon, leading to a progression from tendinopathy to partial- and full-thickness tears[1,2].

The most effective treatment for rotator cuff tear in older individuals is still a matter of debate[3].Several writers propose conservative treatment using physical therapy and exercise as the means to accomplish complete pain eradication and restoration of normal function[4].Nevertheless, the senior population has shown a growing preference for surgical interventions in order to enhance or regain shoulder functionality, enabling them to engage in strenuous activities[5]. There are two surgical alternatives available for treating rotator cuff tears (RCTs) in older patients: reverse total shoulder arthroplasty (RTSA) and arthroscopic rotator cuff repair (ARCR). The choice between these treatments depends on factors such as the size of the tear, the quality of the tendon, and the possibility of repairing the rip. RTSA is recommended for severe and irreversible rotator cuff tears, with or without glenohumeral osteoarthritis. It has been

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shown to result in significant clinical and functional benefits[7, 8].Nevertheless, it is not highly economical and can result in substantial complexities[9].Reverse total shoulder arthroplasty (RTSA) can be regarded as a secondary or salvage treatment in cases when primary anatomical reverse shoulder arthroplasty (ARCR) has failed, save for those with severely compromised tendon condition and advanced joint degeneration[10].

Prior research[11,12] has shown that patients with severe rotator cuff injuries typically had more favourable surgical results, potentially due to enhanced tendon repair and a shorter time between injury and surgery. Nevertheless, the impact of the length of injury on postoperative results in surgically treated patients with traumatic and nontraumatic conditions has yet to be fully understood, as the optimal timing for surgery in RCI remains a subject of controversy[13, 14].Hence, it is crucial to have evidence-based knowledge regarding the surgical treatment of both traumatic and non-traumatic rotator cuff repairs in order to attain the best possible results for patients.

The objective of this study was to analyse and contrast the outcomes of repairing rotator cuff injuries caused by trauma and those caused by non-traumatic factors, at different time intervals.

MATERIALS AND METHODS

This retrospective study enrolled patients attending to the Department of Orthopaedics. It was approved by our Institutional Review Board, and the requirement for informed consent was waived by the committee owing to the retrospective nature of the study. Among the 112 rotator cuff injury patients whose charts were reviewed, 100 met the inclusion criteria. All procedures were performed by the same experienced sports medicine physician and two assistants. The inclusion criteria were as follows:

1. Patients aged above 18 years with a minimum follow-up duration of 6 months;
2. Preoperative magnetic resonance imaging (MRI) was used for the diagnosis of rotator cuff injury;
3. Patients undergoing primary arthroscopic rotator cuff repair.

The exclusion criteria were:

1. Comorbid shoulder osteoarthritis, shoulder instability, or fracture.
2. A history of shoulder surgery on the same side.

METHODOLOGY

The clinical data of patients were obtained through a thorough examination of their medical records, which included information such as age, gender, affected limb side, smoking status, history of hypertension and diabetes mellitus, and mode of repair. Preoperative and postoperative follow-up involved the collection of clinical data. The VAS score, American Shoulder and Elbow Surgeons (ASES) score, Constant Shoulder Function score, and the University of California at Los Angeles scoring system (UCLA) were evaluated using questionnaires and physical examination. Meanwhile, the range of motion (ROM) of shoulder mobility was assessed using active movements, including shoulder forward flexion (FF), external rotation (ER), and internal rotation (IR). The tear type, whether total or partial, was determined based on MRI images and intraoperative exploration of tendon integrity and involved tendons. Additionally, the acromion morphology and the effectiveness of acromioplasty were assessed to determine the most suitable repair technique, which could be either single-row suture, double-row suture, or suture bridge technique (Fig. 1). Postoperative problems occurring after rotator cuff repair were noted at clinical follow-up visits. Final outcomes, such as the occurrence of rotator cuff retear and joint stiffness, were recorded at the 6th month. Shoulder stiffness is characterised by a forward elevation of less than 120°, external rotation of less than 30°, and internal rotation of the back of less than L3. Two senior radiologists assessed the imaging data without knowledge of the details.

STUDY COHORTS

Based on the history of trauma events and the presence of muscle edema in magnetic resonance images, patients were categorized into either the trauma group or the non-trauma group. Subsequently, each group was further stratified into early repair and delayed repair subgroups, resulting in a total of four groups. Within the trauma group, patients were classified into the early repair subgroup if the interval between shoulder cuff injury and surgery was within 3 months, whereas those with an interval exceeding 3 months were assigned to the delayed repair subgroup. Likewise, patients in the non-trauma group were categorized into the early repair subgroup if the duration of reported pain was less than 3 months and into the delayed repair subgroup if the duration exceeded 3 months. Comparisons were made between preoperatively and postoperative values at final follow-up within each cohort and between cohorts.

STATISTICAL ANALYSIS

Statistical analyses were performed using SPSS Statistics 24.0 (Version 20.0, IBM Corporation, Armonk, NY), and differences were considered statistically significant at $p<0.05$.

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RESULTS

Table 1: Baseline characteristics of patients undergoing early and delayed repair in the trauma and non-trauma groups

	Early repair	Delayed repair	*P*-Value
Traumatic *n* = 50			
Gender			0.643
Male, n	14	10	
Female, n	13	13	
Age, years	59.64 ± 6.84	59.28 ± 4.99	0.812
Left shoulder, n	10	8	0.743
Right shoulder, n	17	15	
Tobacco use, n	9	7	0.731
Diabetes, n	5	6	0.680
Hypertension, n	6	8	0.300
Tear area, cm²	4.14 ± 1.19	3.86 ± 0.81	0.409
Duration of surgery, minutes	102.86 ± 14.33	100.39 ± 10.56	0.546
Repair technique, n			0.748
Single row	10	10	
Double row	17	13	
Full layer tear, n	15	11	0.750
Number of patients preoperative physiotherapy, n	7	10	0.185
Number of acromioplasty patients, n	10	12	0.339
Nontraumatic*n* = 55			
Gender			0.760
Male, n	9	12	
Female, n (%)	13	21	
Age, years	60.33 ± 6.48	60.62 ± 6.98	0.889
Left shoulder, n	8	11	0.869
Right shoulder, n	14	22	
Tobacco use, n	6	7	0.673
Diabetes, n	5	6	0.788
Hypertension, n	6	8	0.901
Tear area, cm²	3.08 ± 0.38	3.12 ± 0.36	0.775
Duration of surgery, minutes	90.50 ± 13.11	91.72 ± 11.81	0.742
Repair technique, n			0.948
Single row	9	13	
Double row	13	20	
Full layer tear, n	7	14	0.345
Number of patients preoperative physiotherapy, n	8	20	0.055
Number of acromioplasty patients, n	14	24	0.493

Among patients with traumatic RCI, 27 patients underwent early repair, and 23 patients underwent delayed repair. Amongst patients with non-traumatic RCI, 22 patients underwent early repair, and 33 patients underwent delayed repair. In the traumatic group, gender, age, side of the affected limb, the proportion of smokers, hypertensive patients and diabetes patients, as well as tear area, duration of surgery, type of repair, number of full-layer tears and proportion of patients undergoing preoperative physical therapy and acromioplasty were comparable between the early and delayed repair groups. Similarly, in the non-traumatic group, gender, age, side of the affected limb, the proportion of smokers, hypertensive patients and diabetes patients, as well as tear area, duration of surgery, type of repair, number of full-layer tears and proportion of patients who received preoperative physical therapy and acromioplasty were comparable between the early and delayed repair groups.

Table 2: Torn tendons of patients undergoing early and delayed repair in the trauma and non-trauma groups

	Early repair	Delayed repair	*P*- Value
Traumatic n = 50			
1 tendon	7	8	0.509
Supraspinatus	6	8	0.315

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Subscapularis	1	0	>0.99
2 tendons	14	8	0.335
Supraspinatus and infraspinatus	10	5	0.526
Supraspinatus and subscapularis	5	3	0.709
3 tendons: supraspinatus, infraspinatusandsubscapularis	1	2	0.579
Nontraumatic n = 55			
1 tendon	11	13	0.474
Supraspinatus	10	12	0.563
Subscapularis	1	1	> 0.99
2 tendons	7	14	0.529
Supraspinatus and infraspinatus	5	12	0.345
Supraspinatus and subscapularis	2	2	0.631
3 tendons: supraspinatus, infraspinatusand subscapularis	1	2	> 0.99

In terms of involved tendons, there were no significant differences between the early repair subgroup and the delayed repair subgroup in the trauma and non-trauma groups.

Table 3: Preoperative and postoperative results in patients undergoing early and delayed repair in the trauma and non-trauma groups

	Preoperative		***P*-Value**	**Postoperative**		***P*-Value**
	Early repair	**Delayed repair**		**Early repair**	**Delayed repair**	
Traumatic n = 50						
VAS score	4.86 ± 1.08	4.67 ± 0.84	0.531	1.18 ± 0.91	1.83 ± 1.04	0.041
ASES score	40.38 ± 6.56	40.93 ± 6.10	0.787	82.89 ± 2.67	76.49 ± 4.00	< 0.001
Constant score	33.18 ± 4.62	33.11 ± 1.75	0.948	81.73 ± 4.62	77.28 ± 4.71	0.005
UCLA score	13.68 ± 1.96	14.27 ± 1.74	0.316	31.14 ± 1.52	28.56 ± 2.25	< 0.001
ROM FF	87.41 ± 28.35	89.89 ± 24.91	0.773	149.55 ±15.89	139.44 ± 12.10	0.032
ROM ER	44.77 ± 10.63	45.00 ± 8.23	0.941	55.86 ± 5.93	49.44 ± 5.91	0.002
ROM IR	24.55 ± 8.44	24.17 ± 8.27	0.887	41.36 ± 8.50	36.11 ± 6.98	0.038
Number of patients with joint stiffness, n				3	4	0.642
Number of patients with rotator cuff retear, n				2	7	0.033
Nontraumatic n = 55						
VAS score	4.17 ± 1.04	4.52 ± 1.12	0.291	1.61 ± 1.24	1.72 ± 1.10	0.746
ASES score	47.72 ± 7.96	46.31 ± 6.27	0.504	80.65 ± 4.79	80.06 ± 3.38	0.624
Constant score	38.33 ± 4.07	36.31 ± 5.84	0.205	81.61 ± 4.30	80.31 ± 3.44	0.259
UCLA score	16.44 ± 1.82	16.76 ± 1.53	0.528	31.28 ± 2.27	30.07 ± 2.37	0.091
ROM FF	102.78 ± 19.27	100.69 ± 20.73	0.732	145.83 ± 20.95	142.07 ± 24.29	0.590
ROM ER	48.61 ± 11.73	45.34 ± 13.88	0.411	55.56 ± 8.56	48.62 ± 14.26	0.043
ROM IR	31.94 ± 12.02	30.52 ± 6.99	0.651	42.22 ± 6.24	39.14 ± 8.46	0.188
Number of patients with joint stiffness, n				3	7	0.692
Number of patients with rotator cuff retear, n				4	9	0.492

Preoperative VAS score, ASES score, Constant score and UCLA score were comparable between patients undergoing early and delayed repair in the trauma group. Likewise, there was no significant difference in preoperative VAS score, ASES score, Constant score or UCLA score between early and delayed repair patients in the non-trauma group. However, during postoperative follow-up, functional scores such as VAS scores, ASES scores, Constant scores and UCLA scores were higher in the trauma group of patients undergoing early repair than those undergoing delayed repair. On the other hand, during the follow-up of patients undergoing early and delayed repair in the non-trauma group, no statistically significant differences were observed in VAS scores, ASES scores, Constant scores and UCLA scores.

DISCUSSION

Rotator cuff injury (RCI) is a common ailment that is characterised by discomfort and impaired shoulder function in adults, especially in older individuals[15-17].Increasing research suggests that among adults who are 60 years old or older, 36% report shoulder pain,

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whereas 16.9% of individuals without symptoms develop shoulder tears. The causes of rotator cuff injuries are diverse, encompassing both intrinsic (nontraumatic) and extrinsic (traumatic) elements, as well as societal influences[18].The deterioration of tendon tissue in RCI is a slow process, worsened by the vulnerable position of the rotator cuff, making it prone to friction and impingement, finally resulting in partial or full rips of the tendon[19].

Out of the patients who had traumatic RCI, 27 of them had their repair done early, whereas 23 had their repair done at a later time. Out of the patients with non-traumatic RCI, 22 got early surgery, while 33 underwent delayed treatment. Within the traumatic group, there were no significant differences between the early and delayed repair groups in terms of gender, age, side of the affected limb, proportion of smokers, hypertensive patients, diabetes patients, tear area, duration of surgery, type of repair, number of full-layer tears, and proportion of patients undergoing preoperative physical therapy and acromioplasty. Similarly, in the non-traumatic group, there were no significant differences between the early and delayed repair groups in terms of gender, age, side of the affected limb, proportion of smokers, hypertensive patients, and diabetes patients. Additionally, factors such as tear area, duration of surgery, type of repair, number of full-layer tears, and proportion of patients who received preoperative physical therapy and acromioplasty were also comparable between the two groups. Regarding the tendons involved, there were no notable distinctions observed between the subgroup that underwent early repair and the subgroup that underwent delayed repair, both in the trauma and non-trauma groups. A study analysing 188 arthroscopic repairs of isolated supraspinatus tendon rips found that the healing of the tendon alone did not completely explain the subjective satisfaction of patients during follow-up after 1 year[20].This outcome can be attributed to patients having elevated expectations regarding pain alleviation and enhancement in functionality. Significantly, in this study, patients in the trauma group who received prompt repair saw better results, as indicated by higher subjective satisfaction scores on postoperative VAS, ASES, Constant, and UCLA scales, in comparison to those who underwent delayed repair. Gutman*et al*.[21] conducted a study on 206 patients (150 men and 56 females) who had undergone surgical repair for severe rotator cuff tears. The patients were followed up for at least 24 months after the surgery. Notably, patients who had surgery within 4 months after their accident experienced superior functional recovery, which aligns with the findings of the current study. It is important to highlight that Gutman*et al*.[21] found that patients who had tendon rip repair within 2 to 4 months after injury were more likely to be young and had better outcomes. This difference in age may have affected the results of the surgery. On the other hand, there was no significant variation in age between patients in the trauma and non-trauma groups who received early and delayed repair in this study. Although shoulder injuries can have several causes, traumatic instances usually entail direct external forces exerted on the shoulder joint, as indicated by their larger tear size and higher pain scores[22].It is worth mentioning that Kwon *et al*.[23] have developed a new scoring system to evaluate the healing of the rotator cuff. This system suggests that the magnitude of the tear is connected to the extent of tendon involvement, and greater tear areas are associated with higher rates of re-tear after surgery.

The preoperative Visual Analogue Scale (VAS) score, American Shoulder and Elbow Surgeons (ASES) score, Constant score, and University of California, Los Angeles (UCLA) score showed no significant differences between patients receiving early and delayed treatment in the trauma group. Similarly, there was no notable disparity in the preoperative VAS score, ASES score, Constant score, or UCLA score between patients who underwent early repair and those who underwent delayed repair in the non-trauma group. Nevertheless, in the postoperative follow-up, the trauma group of patients who underwent early repair exhibited higher functional scores, including VAS ratings, ASES scores, Constant scores, and UCLA scores, compared to those who underwent delayed repair. However, when monitoring patients who underwent early and delayed repair in the non-trauma group, no statistically significant disparities were found in VAS ratings, ASES scores, Constant scores, and UCLA scores. Moreover, a study conducted by Lähteenmäki*et al*.[24] indicated that treating a rotator cuff rupture before it reaches a size of 2 cm^2 is linked to enhanced postoperative clinical results, with a specific threshold of 2.5 cm^2. In the present investigation, individuals in the trauma group who received prompt repair had tear regions measuring 4.14 ± 1.19 cm^2, whereas those who underwent repair at a later time had tear areas measuring 3.86 ± 0.81 cm^2. Although patients who underwent early treatment had larger tears, their postoperative VAS, Constant, ASES, and UCLA scores were superior to those of individuals who underwent delayed repair. The enhanced postoperative functional scores may have important implications, taking into account the preoperative tear area and muscle degenerative alterations in patients. Extended conservative treatment frequently leads to disappointing results and postpones the ideal timeframe for restoration. Conversely, when non-traumatic injuries are treated with non-surgical methods alongside suitable physical therapy, patients experience improved results[25, 26].Research examining the effects of non-surgical treatment for non-traumatic rotator cuff problems has yielded inconsistent findings. In a study conducted by LambersHeerspink*et al.*, It was shown that there was no discernible disparity in functional results between patients with non-traumatic rotator cuff injury who

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underwent conservative treatment and those who underwent surgical repair, even after a year of follow-up.

CONCLUSION

The study found that repairing traumatic rotator cuff injuries early resulted in better outcomes in terms of restoring range of motion, reducing pain, and lowering the likelihood of re-tear after surgery, compared to delaying the repair. Consequently, doing arthroscopic surgical repair soon after the injury is still the most recommended method for treating traumatic rotator cuff problems. In contrast, repairing non-traumatic rotator cuff injuries early did not result in better clinical results in terms of postoperative joint function and comorbidities. Therefore, it is advised to begin treatment for patients with non-traumatic rotator cuff problems with early physiotherapy and non-surgical therapies.

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