Original article

Comparison of the epidemiology and outcomes of traumatic and nontraumatic rotator cuff tears

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ABSTRACT

Objective: The purpose of this study was to investigate the differences in the epidemiology and outcomes of traumatic and nontraumatic rotator cuff tears.

Methods: Thirty-three patients with traumatic and 46 with nontraumatic rotator cuff tears were included. **Results:** The rate of injury to the long head of the biceps was significantly higher in the traumatic group. Preoperative active forward elevation was significantly lower in the traumatic group.

Conclusion: The outcomes of both groups were good. This may have been because milder preoperative muscle atrophy and a shorter duration of symptoms were observed in the traumatic group.

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1. Introduction

Rotator cuff tears are main causes of shoulder pain and dysfunction. Several causes of rotator cuff tears have been reported, including both intrinsic and extrinsic factors. One intrinsic factor is age-related tendon degeneration.^{1,2,3} Conversely, according to Neer,⁴ an extrinsic factor is impingement of the supraspinatus tendon on the acromion. However, traumatic events are another cause of rotator cuff tears. When rotator cuff tears occur for other reasons, they may exhibit different characteristics, including various epidemiological factors, clinical outcomes, status of the rotator cuff, and pathology of the long head of the biceps (LHB). However, little is known about the differences between traumatic and nontraumatic rotator cuff tears.

Braune et al.⁵ reported that patients with traumatic rotator cuff ruptures are younger than those with nontraumatic ruptures. Kukkonen et al.⁶ reported that the size of rotator cuff tears in the traumatic group was significantly larger than that in the non-traumatic group, although the average age in both groups was similar.

The purpose of this study was to investigate the differences, including epidemiology, comorbidities, clinical outcomes, range of motion (ROM), muscle atrophy, size of rotator cuff tears, retear rate, and pathological features of the LHB between traumatic and nontraumatic rotator cuff tears. The hypothesis was that traumatic rotator cuff tears were likely to occur in male and younger patients than in the nontraumatic rotator cuff tears. Also arthroscopic

rotator cuff repair for traumatic rotator cuff tears would have better results than in the nontraumatic rotator cuff tears.

2. Materials and methods

This retrospective study was approved by our Institutional Review Board. The inclusion criteria were patients who (1) had undergone preoperative magnetic resonance imaging (MRI) documenting a rotator cuff tear, (2) had undergone arthroscopic repair of the rotator cuff tear, and (3) had a minimum 1-year clinical follow-up. Exclusion criteria included (1) cuff tear arthropathy, and (2) previous surgery on the affected shoulder. In total, 82 shoulders (78 patients) underwent arthroscopic rotator cuff repair from 2012 to 2013. The indications for operative treatment of rotator cuff tears at our institute were typical symptoms of shoulder pain and detected dysfunction of the shoulder joint. All patients underwent nonoperative treatment that included a corticosteroid injection to the subacromial space and physical therapy before surgery. One patient was excluded after the record review because of a history of shoulder surgery on the affected side. Among the remaining 81 patients, two were lost during follow-up before 1 year postoperatively, resulting in 79 patients. The overall follow-up rate was 97.5%. The patients were divided into two groups: the traumatic group and nontraumatic group. In cases involving trauma at the onset of symptoms, the rotator cuff tear was determined to be traumatic and the mechanism of injury was recorded.

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2.1. Study variables

2.1.1. Outcomes instruments

Preoperative and postoperative instruments for shoulder function included the Japan Orthopaedic Association (JOA) score, University of California Los Angeles (UCLA) score, American Shoulder and Elbow Surgery (ASES) score, and Constant score. All patients underwent a standardized physical examination performed by the first author (T.T.) both preoperatively and postoperatively. Active ROM was measured with a goniometer and included evaluation of the scapular plane elevation of the shoulder and external rotation with the arm at the side.

2.1.2. Demographics

Demographic variables evaluated in both groups were sex, age, dominant side, symptom duration, comorbidities (heart and vascular disease and diabetes mellitus), smoking status, body mass index, occupation (deskwork, light work including housework, or heavy work), and mechanism of injury.

2.1.3. Radiographic and operative variables

The presence of retears was determined from the baseline MRI report. The size of the rotator cuff tears and pathology of the LHB were evaluated intraoperatively.

2.1.4. Surgical procedure

All operations were performed by the first author (T.T.) with the patient under general anesthesia and in the beach chair position. Depending on the size of the rotator cuff tear, single-row repair for partial tears and small tears was performed; otherwise, conventional suture bridge repair for larger than small tears was performed. Subacromial decompression and anterior acromioplasty were performed in all patients. LHB tendon tenotomy or tenodesis was performed in patients with a positive hourglass test result and in patients with dislocation or subluxation of the LHB as detected from the bicipital groove. Pathological conditions of the LHB were divided into four groups according to the condition of the LHB: absent group (absence of the LHB within the joint), hourglass

group (positive hourglass test result), dislocation group (dislocation or subluxation from the bicipital groove), and fraying group (fraying of the LHB).

A sling was used for 5 weeks postoperatively. At 2 weeks postoperatively in all patients, passive ROM exercise with physical therapy was permitted. At 6 weeks, active ROM exercise was permitted.

2.1.5. Statistical analysis

Mann-Whitney test was used to compare the differences in the outcomes between the two groups. A paired *t*-test was used to compare the differences in the preoperative and postoperative outcomes for each group. Multivariate analysis was done with the chi-square test. SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY) was used for the statistical analyses. The level of statistical significance was set at $P < 0.05$. Results are given as the mean value.

3. Results

3.1. Patient demographics

All patient demographics are listed in Table 1. There were no statistically significant differences in sex or average age between the two groups ($P = 0.14$ and 0.91 , respectively), although the proportion of men was higher in the traumatic group (60.6%) than in the nontraumatic group (43.5%). There were no significant differences in the proportions of the dominant shoulder affected, number of smokers, or body mass index between the two groups ($P = 0.23$, 0.63 , and 0.55 , respectively). The proportion of patients with heart and vascular disease was significantly higher in the nontraumatic group than in the traumatic group ($P = 0.008$). Conversely, the proportion of patients with diabetes mellitus was significantly higher in the traumatic group than in the nontraumatic group ($P = 0.01$). The proportion of patients engaged in light work such as housework was significantly higher in the nontraumatic group than in the traumatic group ($P = 0.03$).

Table 1
Patient Demographics.

	Traumatic group (n = 33)	Nontraumatic group (n = 46)	P value
Males: females, number (%)	20 (60.6): 13 (39.4)	20 (43.5): 26 (56.5)	0.14
Age at surgery $\pm$ SD, year (range)	66.8 $\pm$ 7.1 (49–85)	67.0 $\pm$ 7.7 (48–81)	0.91
Dominant shoulder affected, number (%)	28 (84.8)	34 (73.9)	0.23
Symptom duration $\pm$ SD, month (range)	7.1 $\pm$ 12.9 (1–72)	16.9 $\pm$ 23.2 (1–120)	0.02*
Co-morbidities, number (%)			
Heart and vascular disease	6 (18.2)	21 (45.7)	0.008*
Diabetes mellitus	9 (27.3)	2 (4.3)	0.01*
Smoker, number (%)	4 (12.1)	4 (8.7)	0.63
Mean body mass index in kg/m ² $\pm$ SD, (range)	24.9 $\pm$ 3.9 (18.6–37.7)	24.4 $\pm$ 3.4 (16.6–34.2)	0.55
Occupation, number (%)			
Deskwork	2 (6.1)	1 (2.2)	0.42
Light work (included housework)	10 (30.3)	25 (54.3)	0.03*
Heavy work	10 (30.3)	15 (32.6)	0.83
None	11 (33.3)	5 (10.9)	0.02*
Mechanism of injury, number (%)			
Fall	17 (51.5)	0	
Bring something heavily	8 (24.2)	0	
Sport	3 (9.1)	0	
Others	5 (15.2)	0	
Unclear	0	46	

* Significant P value ($P < 0.05$).

Table 2

Comparison of Preoperative Clinical Scores and Range of Motion Between the Groups.

	Traumatic group (n = 33)	Nontraumatic group (n = 46)	P value
JOA ^b ± SD, (range)	65.6 ^a ± 8.0 (48.0–78.5)	66.9 ^a ± 12.1 (23.0–84.0)	0.58
UCLA ^b ± SD, (range)	14.3 ^a ± 3.0 (7.0–20.0)	14.3 ^a ± 3.8 (4.0–20.0)	0.99
ASES ^b ± SD, (range)	34.0 ^a ± 11.3 (10.3–55.0)	36.0 ^a ± 11.7 (11.7–61.7)	0.45
Constant ± SD, (range)	60.0 ^a ± 16.6 (15.0–84.0)	67.1 ^a ± 13.3 (21.0–96.0)	0.05 [*]
Forward elevation ± SD, degree (range)	129.1 ^a ± 43.1 (30–170)	152.5 ^a ± 21.6 (80–170)	0.006 [*]
External rotation ± SD, degree (range)	44.2 ^a ± 8.8 (10–60)	43.1 ^a ± 9.5 (5–65)	0.57

^a Values are expressed as mean.^b JOA, Japan Orthopaedic Association; UCLA, University of California, Los Angeles; ASES, American Shoulder and Elbow Surgery.^{*} Significant P value (P < 0.05).

3.2. Clinical outcomes

All preoperative clinical scores and ROM in the two groups are listed in Table 2. All clinical scores and ROM demonstrated statistically significant postoperative improvements (Tables 3 and 4). The preoperative Constant score was significantly lower in the traumatic group than in the nontraumatic group, although all postoperative clinical scores were better in the traumatic group than in the nontraumatic group. Preoperative active forward elevation was significantly lower in the traumatic group than in the nontraumatic group (P = 0.006), although there were no significant differences in the postoperative ROM between the two groups.

3.3. Radiographic and operative variables

All radiographic and operative variables are listed in Table 5. The rotator cuff tear sizes and retear rates were similar between the two groups. The proportion of patients with a positive hourglass test result was significantly higher in the traumatic group (56.3%) than in the nontraumatic group (30.8%) (P = 0.04). The proportion of patients with other pathological conditions of the LHB was similar between the two groups.

4. Discussion

Braune et al.⁵ reported that the average age of patients with traumatic rotator cuff tears was significantly younger (34.2 years) than that of patients with nontraumatic rotator cuff tears (54.1 years). The proportion of male patients in their study was 76.7%. In the present study, the number of women was low in both groups, and there was no significant difference in sex between the two groups. However, the proportion of male patients was higher in the traumatic group (60.6%) than in the nontraumatic group (43.5%) (P = 0.14). Additionally, there was no significant difference in the average age between the traumatic group (66.8 years) and nontraumatic group (67.0 years) in the present study.

Several studies^{7–9} have found that early treatment of traumatic rotator cuff tears improves clinical outcomes. However, Björnsson et al.¹⁰ found no difference in healing rates of repaired rotator cuff tears or clinical outcomes in terms of the time of repair. In the present study, the mean duration of symptoms was significantly shorter in the traumatic group (7.1 months) than in the nontraumatic group (16.9 months). This may have been caused by the better clinical results in the traumatic group than in the nontraumatic group.

With respect to comorbidities in this study, the proportion of patients with arterial hypertension was significantly higher in the nontraumatic group than in the traumatic group. Intrinsic factors

Table 3

Comparison of Postoperative Clinical Scores and Range of Motion Between the Groups.

	Traumatic group (n = 33)	Nontraumatic group (n = 46)	P value
JOA ^b ± SD			
6 months	92.2 ^a ± 5.0 (81.0–100)	90.3 ^a ± 6.1 (73.0–100)	0.16
1 year	96.5 ^a ± 4.8 (84.5–100)	95.2 ^a ± 5.9 (75.0–100)	0.38
UCLA ^b ± SD			
6 months	32.1 ^a ± 2.5 (26.0–35.0)	31.4 ^a ± 2.7 (24.0–35.0)	0.29
1 year	33.9 ^a ± 1.6 (30.0–35.0)	33.2 ^a ± 2.6 (25.0–35.0)	0.18
ASES ^b ± SD			
6 months	93.1 ^a ± 5.6 (79.0–100)	88.2 ^a ± 10.0 (65.0–100)	0.01 [*]
1 year	94.0 ^a ± 8.1 (70.0–100)	93.0 ^a ± 9.8 (68.3–100)	0.67
Constant ± SD			
6 months	92.0 ^a ± 6.1 (74.0–98.0)	90.2 ^a ± 7.0 (62.0–98.0)	0.25
1 year	93.5 ^a ± 6.3 (79.0–100)	93.0 ^a ± 6.1 (78.0–100)	0.78
Forward elevation ± SD, degree (range)			
6 months	153.5 ^a ± 19.8 (90–175)	157.8 ^a ± 15.5 (85–175)	0.34
1 year	167.1 ^a ± 7.2 (150–175)	164.2 ^a ± 10.3 (120–175)	0.23
External rotation ± SD, degree (range)			
6 months	55.3 ^a ± 8.7 (30–70)	55.3 ^a ± 7.3 (30–60)	0.98
1 year	58.3 ^a ± 4.3 (50–65)	57.9 ^a ± 4.8 (40–60)	0.71

^a Values are expressed as mean.^b JOA, Japan Orthopaedic Association; UCLA, University of California, Los Angeles; ASES, American Shoulder and Elbow Surgery.^{*} Significant P value (P < 0.05).

Table 4

Comparison of Preoperative and Postoperative Clinical Scores and Range of Motion Between the Groups.

	Preoperative	Postoperative 6 months	Postoperative 1 year
JOA $\pm$ SD			
Traumatic group	65.6 ^a $\pm$ 8.0 (48.0–78.5)	92.2 ^a $\pm$ 5.0 (81.0–100) ^b	96.5 ^a $\pm$ 4.8 (84.5–100) ^c
Non-traumatic group	66.9 ^a $\pm$ 12.1 (23.0–84.0)	90.3 ^a $\pm$ 6.1 (73.0–100) ^b	95.2 ^a $\pm$ 5.9 (75.0–100) ^c
UCLA $\pm$ SD			
Traumatic group	14.3 ^a $\pm$ 3.0 (7.0–20.0)	32.1 ^a $\pm$ 2.5 (26.0–35.0) ^b	33.9 ^a $\pm$ 1.6 (30.0–35.0) ^c
Non-traumatic group	14.3 ^a $\pm$ 3.8 (4.0–20.0)	31.4 ^a $\pm$ 2.7 (24.0–35.0) ^b	33.2 ^a $\pm$ 2.6 (25.0–35.0) ^c
ASES $\pm$ SD			
Traumatic group	34.0 ^a $\pm$ 11.3 (10.3–55.0)	93.1 ^a $\pm$ 5.6 (79.0–100) ^b	94.0 ^a $\pm$ 8.1 (70.0–100)
Non-traumatic group	36.0 ^a $\pm$ 11.7 (11.7–61.7)	88.2 ^a $\pm$ 10.0 (65.0–100) ^b	93.0 ^a $\pm$ 9.8 (68.3–100) ^b
Constant $\pm$ SD			
Traumatic group	60.0 ^a $\pm$ 16.6 (15.0–84.0)	92.0 ^a $\pm$ 6.1 (74.0–98.0) ^b	93.5 ^a $\pm$ 6.3 (79.0–100)
Non-traumatic group	67.1 ^a $\pm$ 13.3 (21.0–96.0)	90.2 ^a $\pm$ 7.0 (62.0–98.0) ^b	93.0 ^a $\pm$ 6.1 (78.0–100) ^c
Forward elevation $\pm$ SD, degree (range)			
Traumatic group	129.1 ^a $\pm$ 43.1 (30–170)	153.5 ^a $\pm$ 19.8 (90–175) ^b	167.1 ^a $\pm$ 7.2 (150–175) ^c
Non-traumatic group	152.5 ^a $\pm$ 21.6 (80–170)	157.8 ^a $\pm$ 15.5 (85–175)	164.2 ^a $\pm$ 10.3 (120–175) ^c
External rotation $\pm$ SD, degree (range)			
Traumatic group	44.2 ^a $\pm$ 8.8 (10–60)	55.3 ^a $\pm$ 8.7 (30–70) ^b	58.3 ^a $\pm$ 4.3 (50–65)
Non-traumatic group	43.1 ^a $\pm$ 9.5 (5–65)	55.3 ^a $\pm$ 7.3 (30–60) ^b	57.9 ^a $\pm$ 4.8 (40–60)

JOA, Japan Orthopaedic Association; UCLA, University of California, Los Angeles; ASES, American Shoulder and Elbow Surgery.

^a Values are expressed as mean.^b Statistically significant difference between preoperative and postoperative 6 months values ($P < 0.05$).^c Statistically significant difference between postoperative 6 months and postoperative 1 year values ($P < 0.05$).**Table 5**

Comparison of Status of Rotator Cuff and Long Head of Biceps Between the Groups.

	Traumatic group (n = 33)	Nontraumatic group (n = 46)
Preoperative Goutallier classification (SSP, ISP, SSC) ^a , number (%)		
Stage 0–2	33 (100), 33 (100), 33 (100)	36 (78.3), 40 (87.0), 42 (91.3)
Stage 3–4		10 (21.7), 6 (13.0), 4 (8.7)
Tear size, (As, Bs, Small, Medium, Large & Massive) ^b , number (%)		
SSP ISP ^a	3 (9.1), 6 (18.2), 8 (24.2), 13 (39.4), 3 (9.1)	5 (10.9), 8 (17.4), 10 (21.7), 14 (30.4), 9 (19.6)
Tear size, (Partial, Fullthickness) ^b , number (%)	(n = 21)	(n = 26)
SSC ^a	16 (48.5), 5 (23.8)	17 (65.4), 9 (34.6)
Retear rate of rotator cuff tear (SSP ISP, SSC) ^a , number (%)		
Postoperative 6 months	1 (3.0), 1 (4.8)	3 (6.5), 1 (3.8)
Postoperative 1 year	1 (3.0), 1 (4.8)	4 (8.7), 1 (3.8)
Type of injury of long head of biceps, number (%)	(n = 16)	(n = 13)
Absent group ^c	3 (18.8)	3 (23.1)
Hourglass group ^c	9 (56.3)	4 (30.8)
Dislocation group ^c	2 (12.5)	3 (23.1)
Fraying group ^c	2 (12.5)	3 (23.1)

^a SSP, supraspinatus; ISP, infraspinatus; SSC, subscapularis.^b As, articular side tear; Bs, bursal side tear; Small, <1 cm; Medium, 1–3 cm; Large, 3–5 cm; Massive >5 cm; Partial, partial tear; Fullthickness; fullthickness tear.^c Absent group, absence of long head of biceps within the joint, Hourglass group, positive hourglass test, Dislocation group, dislocation or subluxation from the bicipital group, Fraying group, fraying of long head of biceps.^{*} Significant P value ($P < 0.05$).

such as rotator cuff hypovascularity¹¹ should be noted. Arterial hypertension causes peripheral hypovascularity; consequently, patients with arterial hypertension could presumably have a higher incidence of rotator cuff tears.¹ This finding may have been due to the fact that there were more patients with hypertension in the nontraumatic group (so called natural course of rotator cuff tears) than in the traumatic group. However, the proportion of patients with diabetes mellitus was significantly higher in the traumatic group than in the nontraumatic group. The reason for this is unknown.

With respect to the smoking status, Baunmgarten et al.¹² reported that the dose- and time-dependent relationship between

smoking and the prevalence of rotator cuff tears should be taken into consideration. However, the difference was not statistically significant. In the present study, no significant difference in the proportion of smokers was noted between the two groups.

The proportion of patients engaged in the light work such as housework was significantly higher in the nontraumatic group than in the traumatic group. This might have been related to the natural course of rotator cuff tears in the nontraumatic group. Conversely, the proportion of patients engaged in heavy work was similar between the two groups.

Nathan et al.¹³ reported that an injury mechanism such as a fall onto an outstretched arm is the most common injury pattern. In

this study, the major causes of traumatic rotator cuff tears were falling (51.5%) and carrying a heavy object (24.2%).

In this study, the preoperative Constant score was significantly lower in the traumatic group (60.0 points) than in the non-traumatic group (67.1 points) ($P=0.05$). The Constant score primarily measures ROM and strength. Preoperative active forward elevation was significantly lower in the traumatic group (129.1°) than in the nontraumatic group (152.5°) ($P<0.05$). This was a possible cause of the significant difference in the preoperative Constant scores between the two groups. However, all 6-month and 1-year postoperative scores were better in the traumatic group than in the nontraumatic group. This likely occurred because milder preoperative muscle atrophy and a shorter duration of symptoms were observed in the traumatic group than in the nontraumatic group.

Nathan et al.¹³ reported that the preoperative forward elevation in patients with traumatic rotator cuff tears among four studies showed a weighted average of 80.9° (59 – 95°). These values improved to a postoperative weighted average of 144.9° (88 – 142°) as mentioned in six studies. The preoperative and postoperative external rotation in patients with traumatic rotator cuff tears as reported in four studies averaged 42.4° preoperatively and 49.1° at the final follow-up. In the present study, the preoperative active forward elevation was significantly lower in the traumatic group than in the nontraumatic group; furthermore, a higher incidence of pseudoparalysis was observed in the traumatic group. However, the postoperative ROM in both groups, including active forward elevation and external rotation with the arm at side, was similar.

Kukkonen et al.⁶ evaluated the outcomes of surgically treated traumatic versus nontraumatic rotator cuff ruptures, although the healing rates according to MRI findings were not reported. In the present study, we examined all postoperative healing rates using MRI in both groups. However, there was no significant difference in the retear rate between the two groups. Furthermore, the size of the rotator cuff tears, including the subscapularis tendon, was similar between the two groups.

Namdari et al.¹⁴ reported that 77.0% of patients had pathological changes of the biceps tendon, although one of their inclusion criteria was a $>50.0\%$ subscapularis tendon tear. Gerber et al.¹⁵ also defined a subscapularis tendon tear as an inclusion criterion and reported that 63% of patients had pathological changes of the biceps tendon. One of the inclusion criteria in the present study was that the rotator cuff tear involving all of subscapularis tendon tear, and 48.5% of patients in the traumatic group and 23.3% in the nontraumatic group had pathological changes of the biceps tendon. The number of patients with a positive hourglass test result was significantly higher in the traumatic group (56.3%) than in the nontraumatic group (30.8%).

The present study has some limitations. First, with the small number of patients reported. Second, the follow-up period was only 1 year, which might be considered too short. However, all clinical scores in the two groups had significantly improved 1 year after arthroscopic rotator cuff repair. Additionally, we evaluated all patients' retear rates by MRI at both 6 months and 1 year postoperatively. Third, the definition of traumatic rotator cuff tear was difficult due to the lack of the way of definite diagnosis. However, in this study, it was defined as traumatic rotator cuff tear only patients who were asymptomatic in the affected shoulder before the traumatic event and who were able to recall the specific date of the symptom.

A further study is needed to investigate the long-term outcomes between traumatic and nontraumatic rotator cuff tears.

5. Conclusion

In this study, traumatic rotator cuff tears were more likely to occur in male patients and were more closely associated with lower preoperative active forward elevation, milder preoperative muscle atrophy, and a higher rate of injury to the long head of the biceps than were nontraumatic rotator cuff tears. However, although the preoperative active forward elevation was lower and the rate of injury to the long head of the biceps was higher in the traumatic group than in the nontraumatic group, both groups exhibited good outcomes. This may have been associated with the milder preoperative muscle atrophy and shorter duration of symptoms in the traumatic group than in the nontraumatic group.

Disclaimer

The authors, their immediate family, and any research foundation with which they are affiliated did not receive any financial payments or other benefits from any commercial entity related to the subject of this article.

Ouryouji Orthopaedic Hospital Institutional Review Board (IRB) approved this study on April 1, 2014 (IRB No.: 2014-04-001)

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