



# ARTHROSCOPIC ROTATOR CUFF REPAIR USING TENSION BAND TECHNIQUE

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## ABSTRACT

**Background:** Tension band technique is based on the tension band principle, using between 2 and 5 inverted horizontal mattress sutures placed through the tendon and anchors placed in the lateral cortex of the greater tuberosity. Regardless of good pain relief, experience has shown that if the rotator cuff does not heal, functional results are suboptimal.

**Aim and objectives:** to assess the functional outcome of tension band technique repair with both subjective and objective outcome scores and patient satisfaction using tension band technique in a comparable patient population.

**Subjects and methods:** This prospective study was performed on 30 patients with rotator cuff tears.; all patients were selected from Kasr einy and El Helal hospitals. The first case was managed in Nov. 2014 and the last in April 2016. The mean follow-up period ranged between 20 months (first case) and 12 months (last case).

**Results:** there was a statistically significant difference between the studied population regarding Pain assessment, Significant Improvement in postoperative range of motion, Elevation (Forward and Lateral) of patients, Frequency and percentile Internal rotation of patients and External rotation of patients

**Conclusion:** Arthroscopic repair with the modified tension band suture technique for rotator cuff tears was a more suitable method for small to medium tears than for large to massive tears.

**Keywords:** Arthroscopic Rotator, Cuff Repair, Tension Band Technique.

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## INTRODUCTION

Surgical treatment of rotator cuff pathology has undergone dramatic changes in a short, 10 years' time. This is due to, in part to novel ideas, recent biomechanical research, and new technological innovation. The current state of arthroscopic rotator cuff repair focuses on anatomic restoration of the supraspinatus footprint. Regardless of good pain relief, experience has shown that if the rotator cuff does not heal, functional results are suboptimal (1). In an effort to provide the most favorable condition for tendon healing, recent attention has shifted to the tension band principle (2).

Standard single-row fixation does provide improved ultimate load to failure but fails to restore contact area and pressure as well as double row constructs that incorporate interconnectivity (3).

The tension band technique is based on the tension band principle, using between 2 and 5 inverted horizontal mattress sutures placed through the tendon and anchors placed in the lateral cortex of the greater tuberosity (4).

This improved healing rates that have been associated with improved functional results. We believe that the Tension band technique offers the best option for a structurally sound rotator cuff

repair, and it allows earlier rehabilitation. As P. Boileau et al have explained, this construct has multiple advantages (5).

The purpose of this study was to assess the functional outcome of tension band technique repair with both subjective and objective outcome scores and patient satisfaction using tension band technique in a comparable patient population.

## PATIENTS AND METHODS

This prospective study was performed on 30 patients with rotator cuff tears.; all patients were selected from Kasr einy and El Helal hospitals. The first case was managed in Nov. 2014 and the last in April 2016. The mean follow-up period ranged between 20 months (first case) and 12 months (last case).

**All patients were selected with the following inclusion criteria:** Age 20-70 years old and Small, Medium and large size full thickness rotator cuff tear between 1 and 5 centimeters (measured at its mediolateral width).

**The following exclusion criteria were implemented:** Autoimmune or Rheumatologic disease, Active use of steroids, Previous rotator cuff surgery on the affected shoulder, Significant glenohumeral arthritis, Massive retracted tear,

Upward humeral migration (acromiohumeral distance >6 mm at anteroposterior radiographs with the shoulder in neutral rotation), Axillary nerve and

other neurological injury, Partial tears and Severe muscle atrophy or fatty infiltration stage 3 and 4 according to Goutallier et al classification.

**Table 1: Demographic data:**

	Min-Max	Mean ± S. D
Age	32.0 - 68.0	50.37±10.42

The age ranged between 32 to 68 years with an average age of (50.37±10.42).

**Table (2): Average range of age**

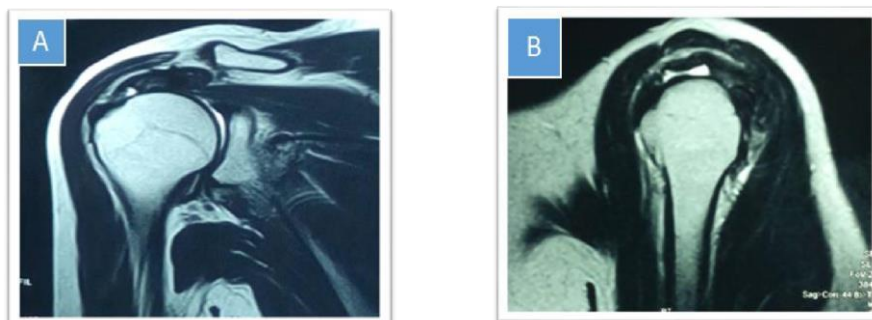
Sex	Frequency	Percent
Female	11	36.7
Male	19	63.3
Total	30	100.0

There were 19 male patients (63.3%) and 11 female patients (36.7%).

**Patient assessment:** Detailed history, examination, radiological findings, and scores using Constant score were recorded for all patients preoperatively and at follow up at one year postoperatively.

**Investigations:** Radiographic examination including plain X rays, routine MRI was performed

in all patients. MRI determines the quality of the rotator cuff muscles, size & site of the tear, amount of retraction, involvement of the bicep's tendon, and differentiation between full and partial-thickness cuff tears.



**Fig. (1) MRI showing rotator cuff tear A: coronal view, B: sagittal view.**

#### Operative Technique:

**Anesthesia:** All patients received general anesthesia with an endotracheal intubation. Hypotensive anesthesia was requested and was very helpful in reducing bleeding. Five patients received interscalene block with general anesthesia.

#### Positioning

Beach chair position was used in all the cases.

The beach chair position allows greater mobility of the arm than does the lateral decubitus position, particularly with respect to internal and external rotation of the shoulder.

A surgical marking pen was used to accurately outline bony A B landmarks of the shoulder. After the patient's anatomy was outlined, the proposed portals were marked.



**Fig. (2): Beach chair position, marking & portals.****Equipment Setup**

After positioning of the patient, the equipment was set up. A tower containing a video monitor, control box, light source, radiofrequency device, and power shaver was set up opposite the operative side (Posterior portal (P), Anteromedial portal (AM), Anterolateral portal (AL) and Lateral portal (L)).

**Preparation and Viewing of the tear & Suture placement and retrieving**

**Postoperative rehabilitation program:** The postoperative rehabilitation program consists of three phases; each phase lasts for six weeks. The

goals of the rehabilitation program are; regaining a full range of motion, normal strength and function, and elimination of pain.

**Statistical Methods:** Statistical analysis was done using Microsoft Excel 2016 and SPSS v15.0 for windows. Significance was tested with the Wilcoxon signed- rank test for related samples, Mann-Whitney test for independent samples, and Pearson correlation test for bivariate variables. Results were considered significant at the 95% confidence interval level.

**RESULTS****Table (3): Pain assessment of patients.**

Pain assessment	Pre		Post		P. Value Between Pre- and Post-Operative
	Frequency	Percent	Frequency	Percent	
None	0	0.0%	27	96.4%	0.001**
Mild	0	0.0%	1	3.6%	
Moderate	9	32.1%	0	0.0%	
Severe	19	67.9%	0	0.0%	
<b>Total</b>	<b>28</b>	<b>100</b>	<b>28</b>	<b>100</b>	

When comparing pre-operative and post-operative pain assessment there were highly statistically significant difference with (P-value<0.001).

**Table (4): Significant Improvement in postoperative range of motion.**

ROM Score	Pre-operative	Post-operative	P. Value
Forward elevation	126.3 ± 30.19	164.3 ± 15.35	0.001**
Lateral elevation	115.5 ± 25.9	158.17 ± 16.32	0.001**
Internal rotation	3.33±2.249	6.47±1.634	0.001**
External rotation	4.53±1.655	6.33±1.900	0.001**

There was marked improvement in range of movement (p<0.05), and Constant scores showed a significant improvement as well (p<0.05).

**Table (5): Elevation (Forward and Lateral) of patients:**

Elevation	Pre		Post		P. Value
	Min - Max	Mean ± S. D	Min - Max	Mean ± S. D	
<b>Forward</b>	70.0 - 170.0	126.3 ± 30.19	140.0 - 180.0	164.3 ± 15.35	0.001**
<b>Lateral</b>	80.0 - 170.0	115.5 ± 25.9	130.0 - 180.0	158.17 ± 16.32	0.001**

When comparing pre-operative and post-operative there were highly statistically significant difference with (P-value<0.001)

**Table (6) Frequency and percentile Internal rotation of patients:**

Internal rotation	Pre		Post		P. Value
	Frequency	Percent	Frequency	Percent	
Buttock	9	32.1%	0	0.0%	0.01*
Lumbosacral	8	28.6%	5	17.9%	
t12 vertebrae	2	7.1%	8	28.6%	
Thigh	4	14.3%	0	0.0%	
Waist	5	17.9%	13	46.4%	
Inter scapular	0	0.0%	2	7.1%	
<b>Total</b>	<b>28</b>	<b>100</b>	<b>28</b>	<b>100</b>	

When comparing pre-operative and post-operative internal rotation there were statistically significant difference with (P-value<0.01).

**Table (7): External rotation of patients:**

External rotation	Pre		Post		P. Value
	Frequency	Percent	Frequency	Percent	
Hand behind head elbow back	5	17.86%	15	53.57%	0.001**
Hand behind head elbow forward	5	17.86%	0	0.0%	
Hand top head and elbow backward	6	21.43%	10	35.71%	
Hand top head elbow forward	12	42.86%	3	10.71%	
Total	28	100.0%	28	100.0%	

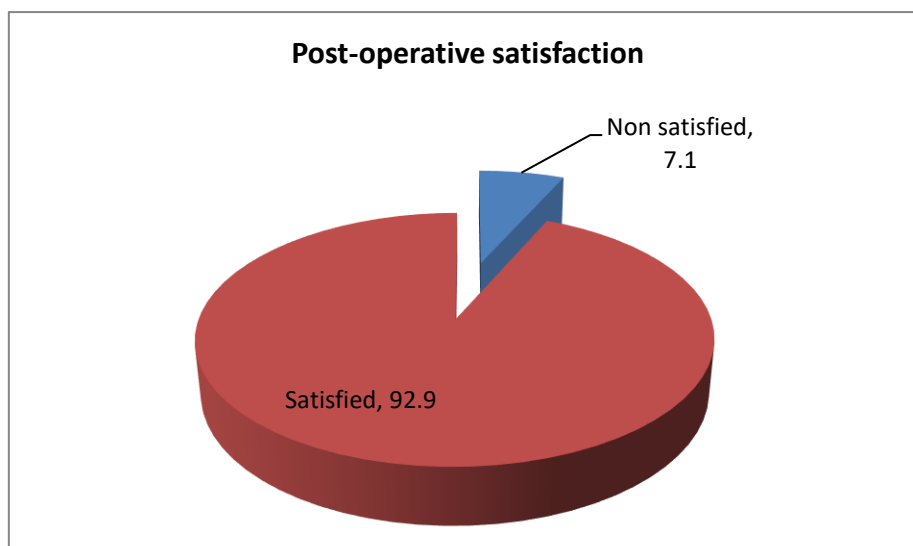
When comparing pre-operative and post-operative there were statistically significant difference with (P-value<0.001).

**Table (8): Intraoperative tear size of patients:**

Intra tear size	Frequency	Percent
Small	12	42.8%
Medium size tear	13	46.4%
Large	2	7.1%
Total	28	100

The present study consists of 12 patients (42.8%) small size tear (< 1 cm), while medium size tears (1 to 3 cm) were 13 patients (46.4%), 2 patients (7.1%) had large size tear (3 to 5 cm). Tear size was measured during repair in the sagittal plane at footprint and classified according to DeOrio and Cofield classification. Only six cases showed postoperative partial healing five of them had

medium sized tear and one case only had large tear pattern. There was no significant correlation between intraoperative tear size and postoperative patient satisfaction and constant score postoperatively. There was a negative correlation between intraoperative tear size and history of trauma in this series.



**Graph (3): Frequency and percentile of post-operative patient satisfaction.**

### CASE PRESENTATION

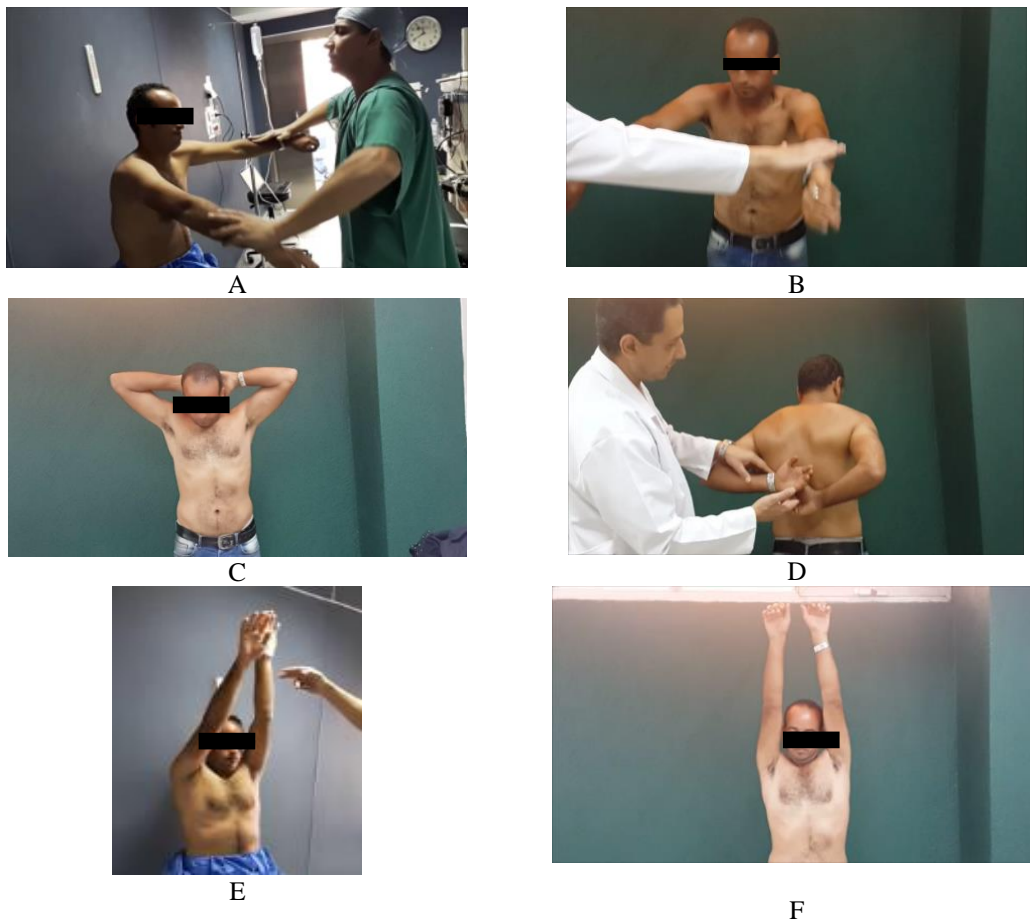
#### Case NO. 1

Male patient 32 years old. Complained of right shoulder pain of 2 months' duration that start with acute onset with relation to trauma falling on right

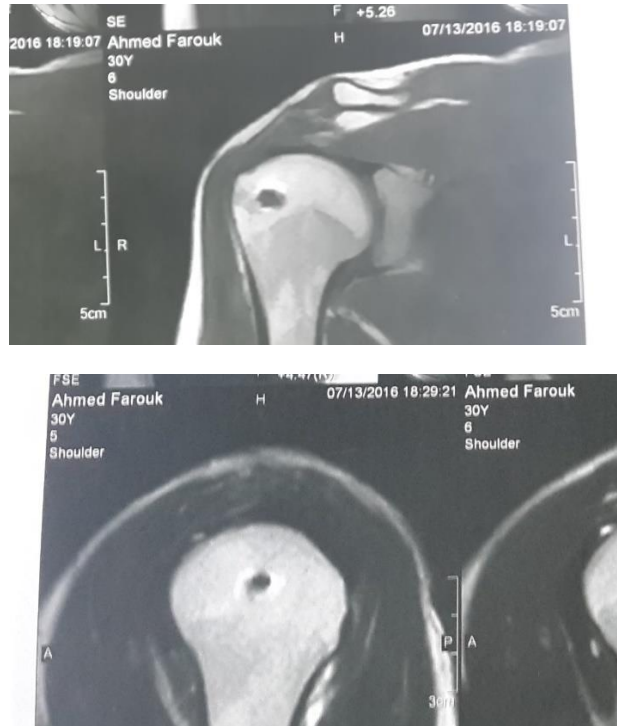
side. The pain was severe, dull aching and mainly in the front and side of the shoulder and upper arm increased after activities and at night but unaffected sleep mild recreation and decreased by analgesics.



**Fig. (4) Preoperative MRI case1**  
A: MRI coronal T2, B:, sagittal MRI.



**Fig (5)** Preoperative and postoperative examination of case 1; A. Preoperative positive Jobe test; B. Postoperative negative jobe test.(after 6 months); C.Postoperative external rotation; D. Postoperative internal rotation; E. Preoperative forward elevation; F. Postoperative forward elevation.

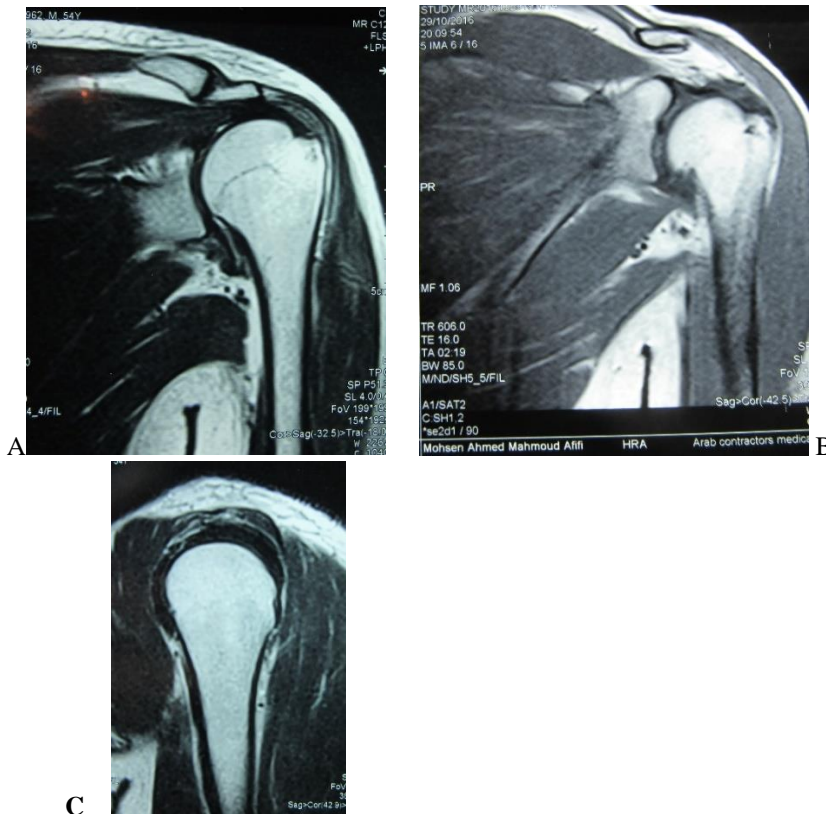


**Fig (6):** showing the post-operative MRI coronal and axial views with good tendon healing

**Case No. 2**

Male patient, 55 years old, complained of left shoulder pain of 4 months' duration that start with insidious onset and no relation to trauma. The pain

was severe, dull aching with night pain interfering with sleep most nights. The patient had a course of physiotherapy with no improvement in pain. Preoperative range of movement was limited.



**Fig (7):** preoperative MRI case 2 showing rotator cuff tear **A:** MRI coronal T2, **B:** MRI coronal T1, **C:** MRI sagittal.



**Fig (8): preoperative and postoperative examination of case 2**  
 A Preoperative forward elevation.

**B** Postoperative forward elevation.  
**C** Preoperative external rotation.  
**D.** Postoperative external rotation.



**Fig (9): Postoperative MRI case 2.**  
**A.**Sagittal MRI sagittal cut 12 months postoperatively.



**B.** Coronal cut showing 12 months postoperative healing

**DISCUSSION**

The current study included 30 patients were managed by arthroscopic tension band repair technique. The follow-up period ranged from 20 months (first case) to 12 months (last case), with a mean follow up of 16.8 months.

Results have shown that there was significant improvement in outcome following modified tension band arthroscopic rotator cuff repair. At final follow up of at least 12 months, there was marked pain relief from preoperative pain score of  $3.5(\pm 2.33)$ , to  $14.33(\pm 1.6)$  postoperatively. 96.7% of the patients were satisfied.

In the current study 6 patients only of 28 patients showed postoperative partial healing detected by postoperative MRI, 5 patients of them have their ages all ranged between 60 and 68 years old and all were diabetic. this may be due to the fact that the capacity to store local reserves of various growth factors involved in the healing processes decrease with age.

Also, a significant correlation with reverse proportion between age of the patients in the study group and their postoperative constant score with ( $r = -0.445$ ) and ( $P$  value = 0.001).

Also, a significant correlation with reverse proportion between the age of the patients and postoperative patient satisfaction with ( $r = -0.534$ ) and ( $p = 0.001$ ).

Functional outcome measures had improved as well; the mean pre-and 6 months postoperative Constant–Murley scores were statistically significant ( $P < 0.001$ ). significant improvement in constant score from preoperative ( $40.9 \pm 9.65$ ) to reach postoperative ( $76.27 \pm 6.85$ ) with ( $P$ -value  $< 0.001$ ). 26 of the 28 patients (92.8%) were satisfied with the overall results after 12 months of the procedure. These non-satisfied patients (7.2 %) all had a long symptomatic period of a mean of 15 months. These patients also had remaining pain and decreased ROM.

Current study showed a strong correlation between patient satisfaction and postoperative range of motion ( $p = 0.002$ ), and postoperative pain ( $p = 0.001$ ), and postoperative functional outcome scores; constant ( $p = 0.001$ ).

A significant association was detected between radiographic signs of tendon healing and the postoperative strength and constant score. Patients with healed tendon had more strength ( $P = 0.001$ ) and a highly better constant score ( $P = 0.02$ ) than did those with incomplete or unhealed repair., the absence of tendon healing did not affect pain relief, activity, mobility, or patient satisfaction

Several studies have reported favorable clinical results after arthroscopic rotator cuff repair.

Boileau et al case series was published at January 2005. the arthroscopic series were sixty five consecutive shoulders with full thickness supraspinatus tear which were repaired all

arthroscopically with use of tension band technique. Patients ranged in age between twenty nine to seventy nine years (6).

The present study consists of 13 patients (46.4%) small size tear ( $< 1$  cm), while medium size tears (1 to 3 cm) were 12 patients (42.8%), 3 patients (10.7%) had large size tear (3 to 5 cm).

We find a significant positive correlation between intra tear size and post operative constant score with ( $r = 0.466$ ,  $p = 0.009$ ).

Non healing (failed repair) was noticed in one case with large size tear and this may be caused by the limitation in the repair strength and the contact pressure achieved using the arthroscopic modified tension band suture technique for large tears. Furthermore, this may also be due to the medial portion of the tendon not contacting the bone when the shoulder is abducted.

A retrospective case control study published by Kyu Hwan Bae et al in 2016, A number of 47 consecutive patients underwent arthroscopic rotator cuff repair with the modified tension band suture technique by a single surgeon (J.W.K.) from July 2011. The study group comprised 29 men and 18 women with a mean age of 59.9 years (range, 46-75 years. The DeOrto and Cofield classification was used to categorize the tears the small and medium tears were allocated to group A and the large tears to group B (7).

The mean Constant score improved from 42 preoperatively to 79 at the final follow-up ( $P < 0.001$ ).

Kyu Hwan Bae et al did arthroscopic rotator repair with a modified tension band suture technique for full thickness rotator cuff tears of all sizes would lead to satisfactory clinical outcomes and repair integrity (7).

In the in a study done by P. Boileau et al, 2004. The size of the initial tear also influenced the healing rate, particularly in the sagittal plane. Healing rate was significantly lower when the initial tear was associated with a delamination extending to the infraspinatus posteriorly and the subscapularis anteriorly. All small supraspinatus tears with moderate retraction in the frontal plane and no associated delamination of the infraspinatus or subscapularis (Stage I, D) achieved complete healing (19/19) (8).

Age-related degeneration and trauma have been implicated in the pathogenesis of rotator cuff tears (9). Cadaveric studies have shown that the tensile strength of the supraspinatus tendon decreases with age (10). rotator cuff tears are often but not always associated with shoulder trauma (11).

In the current (tension band) study No retear rates were detected in both traumatic and non-traumatic groups.

In the Seven cases who have history of trauma, only one case showed partial healing of the cuff after 12 months of followup this patient was 61 years old male and he was diabetic, the other six cases showed



complete healing with 6 months postoperative MRI, Also a strong correlation between traumatic rotator cuff tear and postoperative constant score ( $R= 0.584$ ) and ( $P=0.001$ )

Also, traumatic rotator cuff tear patients showed a significant postoperative correlation with strength of abduction ( $p=0.005$ ) and postoperative forward ( $p=0.004$ ) and lateral elevation ( $p=0.003$ ). and showed significant negative correlation with age of the patients

There have, however, been few clinical studies determining if traumatic rotator cuff tears heal better than nontraumatic rotator cuff tears.

Braune et al. found that traumatic rotator cuff tears occurred in younger patients, and these younger patients had better postoperative functional outcomes compared with older patients with nontraumatic tears (12).

MacKechnie et al. found in their systematic review that full-thickness rotator cuff tears in patients younger than 55 years were mostly traumatic and responded clinically well to both open and arthroscopic rotator cuff repair (13).

In a cohort study done by Martin Tan et al, 2016. they hypothesized that there will be a lower prevalence of retear and good healing after rotator cuff repair in patients with a history of a specific traumatic event to their shoulders than in those who could recall no such episode, they project a study cohort of 1300 consecutive patients in the study group. Of these patients, 811 had reported a traumatic injury at their initial visit (traumatic group), and 489 patients reported no significant injury (nontraumatic group) (14).

## CONCLUSION

Arthroscopic repair with the modified tension band suture technique for rotator cuff tears was a more suitable method for small to medium tears than for large to massive tears.

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