Transposition of Long Head of Biceps as a Dynamic Sling in Treatment of Recurrent Shoulder Dislocation

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Abstract

Background: The glenohumeral joint is the most commonly dislocated major joint. Traumatic shoulder dislocation affects about 1.7% of the population, with higher rates in men, contact athletes, and military personnel.

Aim: To clinically assess, using the Rowe score, the effectiveness of arthroscopic trans-subscapular transposition of the long head of the biceps (LHB) as a dynamic sling for treating recurrent shoulder dislocation.

Methods: This prospective cohort study was conducted in the Orthopedic departments of Beni-Suef and Minia University hospitals from October 2022 to October 2023 and included 30 patients with recurrent shoulder dislocation.

Results: The mean number of dislocations was 4.90± 1.94 and ranged from two to 9. The mean pre-Op Rowe score was 60.43± 10.25 and ranged from 39 to 78. The mean post-operative Rowe score was 82.0± 6.71 and ranged from 65 to 91. There was a significant difference between pre-operative and post-operative Rowe score ($p<0.001$) as Rowe score was significantly increased postoperatively compared to preoperatively. There was no significant difference between males and females regarding post-operative Rowe score ($p=0.750$).

Conclusion: This study evaluated LHB transposition as a dynamic sling for recurrent shoulder instability, effective for glenoid bone loss ≤20%. Fixation with 2-3 anchors showed strong results, low recurrence, and minimal tissue damage, suitable for labral reconstruction/augmentation.

Key words: LHB; Rowe score; Transposition; Shoulder Dislocation.

Introduction

The glenohumeral joint is the most common major joint of the body to dislocate. In general population, the incidence of traumatic shoulder dislocation is 1.7% and it is more common in men, contact athletes and enlisted persons [1, 2].

Anterior shoulder instability contributes 90% of all instabilities [3].

The stability of the shoulder joint is imparted by static and dynamic structures. The glenoid socket, whose concavity is deepened by circumferential fibrocartilaginous labrum, the joint capsule and its thickenings, the coracohumeral ligament and the superior, middle and the inferior glenohumeral ligaments and the joint compression provided by rotator cuff and long head of biceps tendon [4].

The labrum is a fibrocartilaginous structure that doubles the anteroposterior depth of the glenoid socket from 2.5 mm to 5 mm and deepens the concavity to 9 mm in the superio-inferior plane. Additionally, it increases the surface area of contact for the humeral head and thus, enhances the stability of the joint and provides attachment of the glenohumeral ligaments [5].

A Bankart lesion is found in over 80% of shoulders with recurrent shoulder instability [6, 7].

The frequency of dislocation keeps increasing with time and overhead activity, and it is termed as recurrent when dislocation occurs more than once [3]

One of the main causes of recurrence is the labrum and glenohumeral ligaments' poor quality and weakness [8].

Numerous strategies have been put forward to stop recurrence, including the use of allografts and augmentation with a portion of the subscapular muscle's tendon [9].

The aim of the work was to evaluate clinically with Rowe score, the effectiveness of treatment of recurrent shoulder dislocation by arthroscopic trans-subscapular transposition of long head of biceps (LHB) as a dynamic sling to the anterior glenoid margin.

Patients and methods

This prospective cohort study was conducted in the Orthopedic departments of Beni-Suef and Minia University hospitals from October 2022 to October 2023 and included 30 patients with recurrent shoulder dislocation.

Sample size: Was performed using F-tests - ANOVA: Repeated measures, within factors, with an a priori analysis to compute the required sample size. The input parameters included an effect size f of 0.275, an α error probability of 0.05, a power (1-β error probability) of 0.95, 1 group, 4 measurements, a correlation among repeated measures of 0.5, and a non-sphericity correction ε of 1. The output revealed a non-centrality parameter λ of 18.1500000, a critical F of 2.7094021, numerator degrees of freedom of 3.0000000, denominator degrees of freedom of 87.0000000, a total sample size of 30, and an actual power of 0.9520882.

Inclusion criteria: Patients aged 19-45 years, of both sexes, with recurrent shoulder dislocations accompanied by a Bankart lesion and glenoid bone loss of less than 20%, as well as high-risk patients for recurrence of glenohumeral instability, including those with hyperlaxity or involvement in contact or competitive sports activities.

Exclusion criteria: Patients below 19 years or above 45 years of age, epileptic patients, those with glenoid bone loss exceeding 20%, off-track Hill-Sachs lesions, extensive intra-articular lesions of the long head of the biceps (LHB), and individuals with a history of previous shoulder surgery.

Methods

The preoperative data collection involved a detailed evaluation, including a comprehensive history with a focus on the mechanism of injury, a full shoulder examination incorporating anterior shoulder instability tests such as the anterior-drawer test, apprehension test, and crank test, MRI and CT evaluations of the affected shoulder, and the calculation of pain and activity levels using the Rowe score.

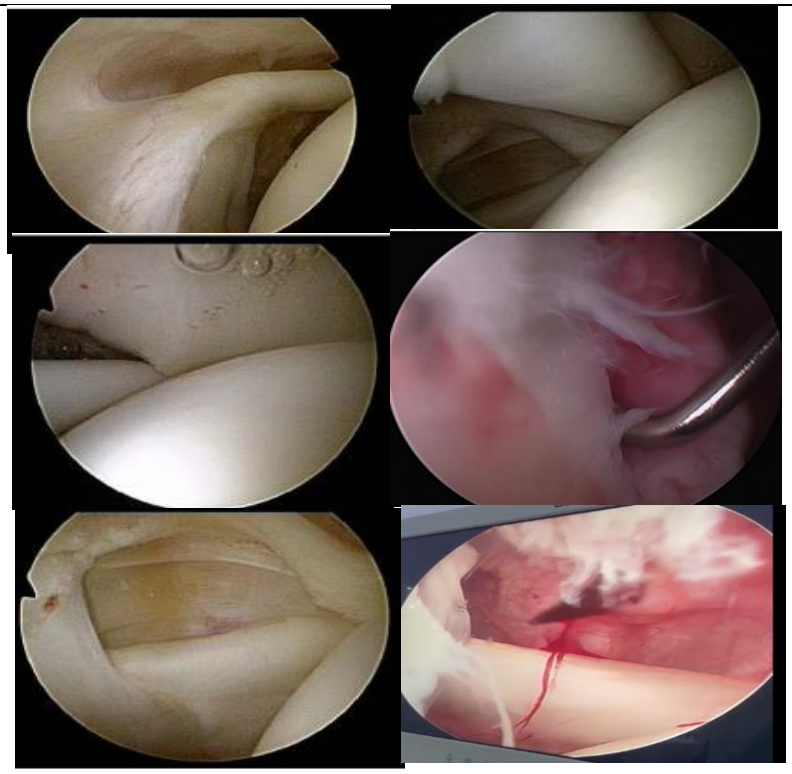
Surgical technique:

The patient was positioned in the beach chair position under general anesthesia with a supraclavicular nerve block for postoperative pain control and administered IV antibiotics. The shoulder was placed at 30° of anterior elevation, 10° of abduction, and neutral rotation. Classic arthroscopic portals were used: Portal A (2 cm medial and inferior to the posterolateral

acromion), Portal B (anterior to the rotator interval, tangential to the upper margin of the subscapularis), and Portal C (2 cm lateral to B and 2 cm inferior to the anterolateral acromion).

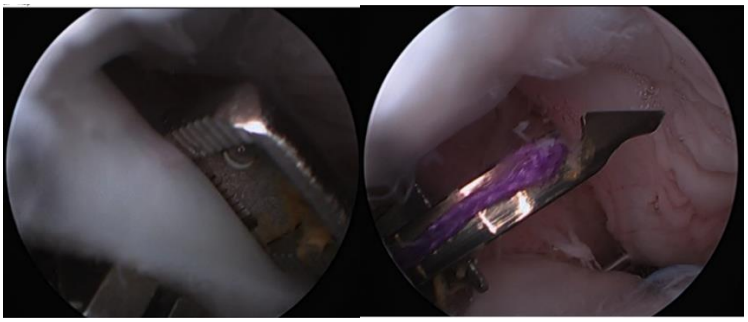
First Step: Diagnostic Arthroscopy and Preparation: A 4-mm arthroscope was inserted through the A portal to perform a standard diagnostic evaluation of the shoulder, documenting a sclerotic anterior glenoid rim and the absence of anterior labral tissue. An arthroscopic rasp was then used via the B portal to release scar tissue and decorticate the anterior glenoid margin from the 3 to 5 o'clock position. The pre-subscapular bursa and the lateral part of the clavipectoral fascia were cleared with a shaver to fully expose the anterior surface of the subscapularis. **Second Step: Suture Management**: A Quattro suture passer with Fiber-wire was introduced through the B portal, engaging the LHBT proximally. The suture was passed into the tendon, and a loop was created above it. Using the D portal, a suture grasper retrieved one suture limb posteriorly and the other anteriorly through the loop, forming a 360 double lasso around the biceps. **Third Step: LHB Tendon Release from Bicipital Groove and Tenotomy**: The suture limbs were pulled outside the shoulder through the B portal. Biceps tenotomy was performed using a radiofrequency ablator or a basket cutter. A mini-open incision was made over the bicipital groove, and the LHB tendon was released from the bicipital tunnel by cutting the transverse humeral ligament laterally and distally to avoid injury to the subscapularis insertion. **Fourth Step: Subscapularis Split**: (This step might be done first.) After cutting the transverse ligament, the long head of the biceps tendon (LHBT) was exteriorized through the mini-open incision distally. The LHB was held using an artery forceps and passed medially to be exteriorized again through the B portal. The arthroscope was placed into the A portal, and a switching stick (or parrot peak) was inserted into the B portal. The rod was advanced from anterior to posterior, parallel to the glenoid surface, until it pierced the subscapularis tendon, with its tip visualized posterior to the conjoint tendon. The subscapularis split was made at one-third inferiorly and two-thirds superiorly, based on the tendon's height. While performing gentle internal-external rotation, the subscapularis split was enlarged and prepared to receive the transtendinous transfer of the LHBT. **Fifth Step: Transferring the LHBT and Tenodesis**: The LHBT sutures were pulled through the subscapularis split using an artery forceps or switching stick and exteriorized through the A portal. The LHBT was transferred through the subscapularis by gently pulling the suture limbs from the A portal while pushing the tendon with a tissue grasper from the E portal. Once the biceps were visualized intraarticularly, its suture limbs were passed over the superior subscapularis margin and retrieved through the E portal. Tenodesis was performed using a 3.5-mm anchor placed on the anterior glenoid margin between 1 and 5 o'clock via the E portal. The sling effect was confirmed in the pre-subscapular space and intraarticularly ("outside and inside the box") using the scope in the D portal. Finally, the suture ends were cut flush to the bone surface. **Sixth Step: Final Arthroscopic Evaluation**: The LHBT transfer was visualized through the D portal, with the scope positioned both anteriorly and posteriorly to the subscapularis, ensuring an "outside and inside the box" view. The scope was directed downward to confirm proper release of the LHBT from the intertubercular groove without kinking. By pointing the scope posteriorly and performing an anterior drawer maneuver, stability was assessed. Finally, gentle glenohumeral external-internal rotation was performed to evaluate the anterior sling effect and confirm proper tendon positioning.

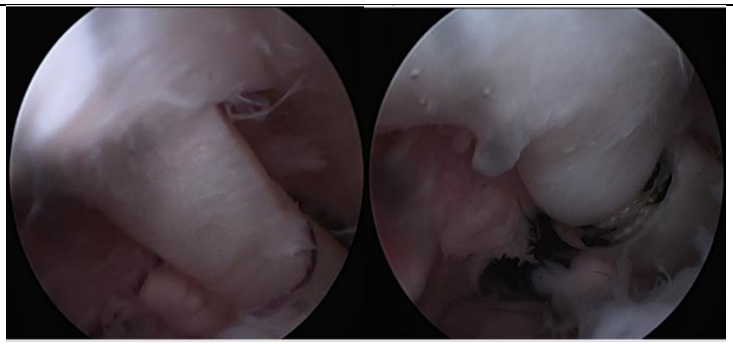
Postoperative follow-up: Included evaluations at 2, 4, and 6 weeks, as well as 2, 4, 6, and 9 months, during which patients will be assessed for shoulder range of motion (ROM) and their ability to return to normal daily activities using the Rowe score.



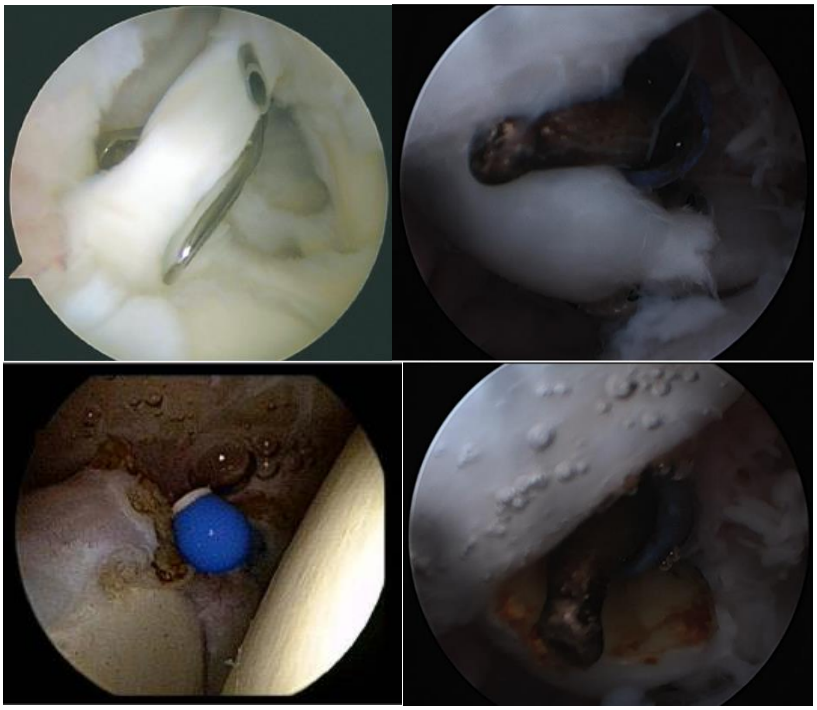
a–h Arthroscopic diagnosis. a biceps tendon anchor; b biceps tendon, c supraspinatus tendon, d Labrum e MGHL; SGHL, f rotator interval with subscapularis tendon

(First step)

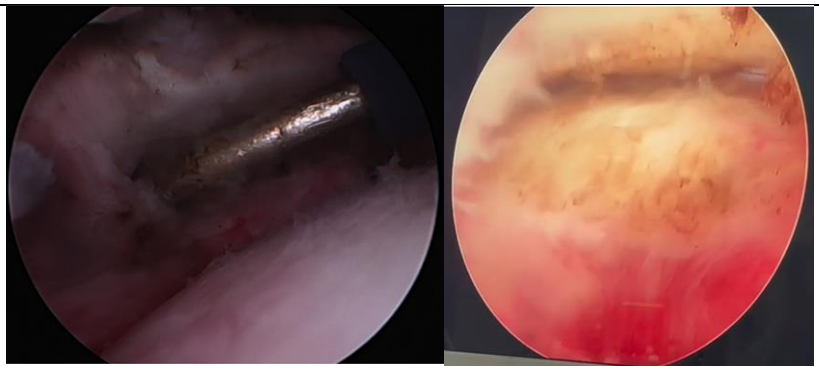




a) Engaged the LHBT proximally by Quattro suture passer b) firing the Quattro suture passer c) Fiber-wire is passed into the LHBT d) another fire to secure the LHB preparation **(Second step).**

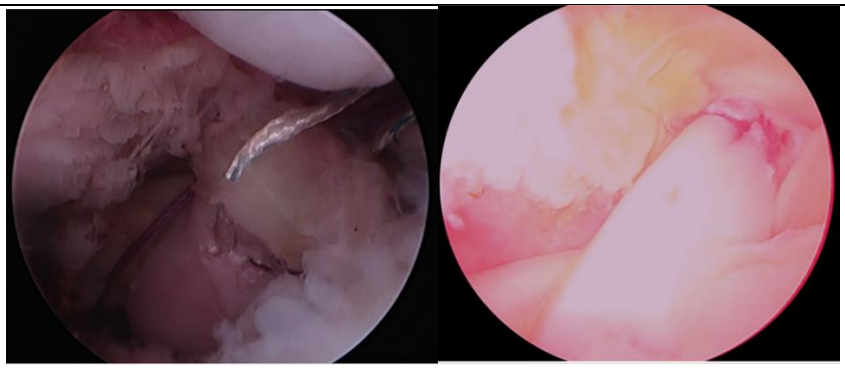


Biceps tenotomy is performed with a radiofrequency ablator or using a basket **(Third Step)**

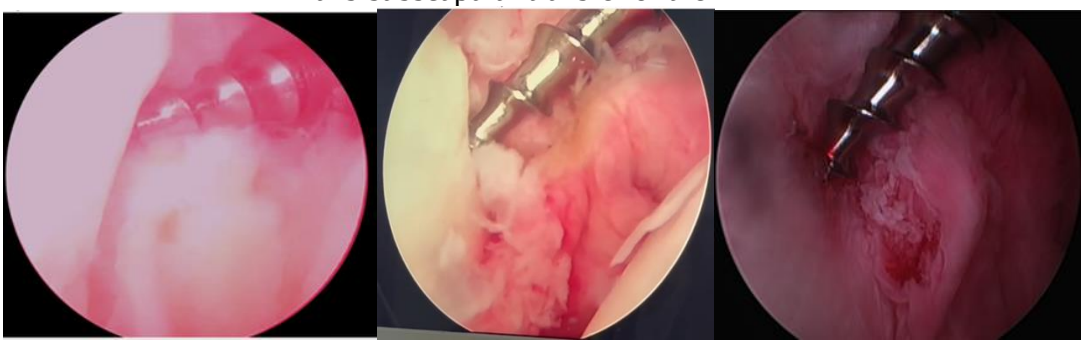


Subscapularis splitting by parrot peak (or switching stick) or by Diathermy

(Fourth step)

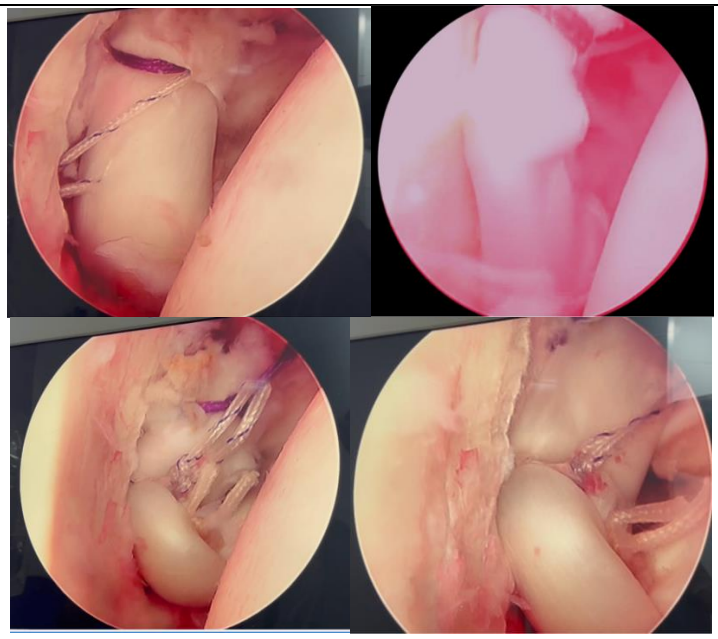


Trans-subscapular transfer of the LHBT



The LHBT tenodesis is performed using a 2 to 3 (3.5- mm anchor)

(Fifth Step)



The LHBT tenodesis is performed using a 2 to 3 (3.5- mm anchor) onto the anterior glenoid margin between 1,3 and 5 o'clock position.

(Sixth Step)

Figure (1): Surgical technique

Ethical considerations

After obtaining human ethical committee approval with registration number (11092022). The research was conducted by scientifically qualified and trained personnel. Informed consent from all participants was taken and all patients' data was confidentially kept.

Statistical analysis:

Data will be collected then entered and coded into the SPSS version 25 for windows. Numeric variables will be expressed as mean and standard deviation while categorical variables will be expressed as number and percent. Relation between categorical variables will be run by chi-Squared or Fisher exact according to the expected values in the cells. Relations between categorical and numeric variables will be done by independent t test or Mann whitney U test according to normality distribution. Spearman Rho or person correlation will be run between numeric variables according to normality. *P-value less than or equal 0.05 will be considered significant.

Results

Table 1 illustrates demographic characteristics of the studied patients. The age of patients ranged from 20 to 44 years with mean age ±SD being 27.83± 4.79 years. There was higher prevalence of males (93.3%) that overweigh female (6.7%) with male to female ratio was 14:1.

Table 2 showed that, eighteen (60%) patients had shoulder dislocation at right side while 12 (40%) of them were on left side.

Table 3 showed that, the mean number of dislocations was 4.90± 1.94 and ranged from two to 9.

Table 4 showed that, the mean pre-Op Rowe score was 60.43± 10.25 and ranged from 39 to 78.
Table 5 showed that, the mean post-operative Rowe score was 82.0± 6.71 and ranged from 65 to 91.
Table 6 showed that, there was a significant difference between pre-operative and post-operative Rowe score ($p<0.001$) as Rowe score was significantly increased postoperatively compared to preoperatively.
Table 7 showed that, there was no significant difference between males and females regarding post-operative Rowe score ($p=0.750$).

Table (1): Demographic characteristics of the studied patients.

Parameters		Studied patients (N= 30)	
		N	%
Gender	Male	28	93.3%
	Female	2	6.7%
Age (years)	Mean± SD	27.83± 4.79	
	Median	28.0	
	Range	20.0 – 44.0	

SD= standard deviation, n: number, %: percentage,

Table (2): Side of dislocation among the studied patients.

Parameters		Studied patients (N= 30)	
		N	%
Side	Right	18	60.0%
	Left	12	40.0%

SD= standard deviation, n: number, %: percentage,

Table (3): Number of dislocations among the studied patients.

		Studied patients (N= 30)
Number of dislocations	Mean± SD	4.90± 1.94
	Median	4.5
	Range	2.0 – 9.0

SD= standard deviation,

Table (4): Pre-operative Rowe score among the studied patients.

		Studied patients (N= 30)
Pre-Op Rowe score	Mean± SD	60.43± 10.25
	Median	62.0
	Range	39.0 – 78.0

SD= standard deviation,

Table (5): Post-operative Rowe score among the studied patients.

		Studied patients (N= 30)
Post-operative Rowe score	Mean± SD	82.0± 6.71
	Median	83.0
	Range	65.0 – 91.0

SD= standard deviation,

Table (6): Comparison between pre-operative and post-operative Rowe score.

	Rowe score		Paired T Test	
	Mean ± SD	Range	Test value	p- value
Pre-operative	60.43±10.25	39.0 – 78.0	18.37	**<0.001**
Post-operative	82.0±6.71	65.0 – 91.0		

p>0.05 is not significant, p≤0.05 is significant, p≤0.01 is high significant,

Table (7): Relation between post-operative Rowe score and gender.

		Post-operative Rowe score		Student T Test	
		Mean ± SD	Range	Test value	p- value
Gender	Male	81.89±6.83	65.0-91.0	0.322	0.750
	Female	83.50±6.36	79.0-88.0		

p>0.05 is not significant, p≤0.05 is significant, p≤0.01 is high significant,

Discussion

In our study, the age of patients ranged from 20 to 44 years with mean age ±SD being 27.83± 4.79 years. There was higher prevalence of males (93.3%) that overweigh female (6.7%) with male to female ratio was 14:1.

In agreement with our results, Parmar RS et al.,[10] who aimed to evaluate the outcomes of arthroscopic repair of Bankart at the intervening time intervals in traumatic recurrent dislocation of shoulder joint. They found that in patients who have a history of traumatic recurrent shoulder

joint dislocation, Age was 26.40 + 5.739. There was higher prevalence of males 28 (93.33%) that overweigh female 2 (6.66%) with male to female ratio was 14:1.

In our study showed that, as regard the side of dislocation among our studied patients, there were eighteen (60%) patients had shoulder dislocation at right side while 12 (40%) of them were on left side.

Also, Gasparini G et al, [11] they reported that in patients with traumatic anterior shoulder instability, as regard affected side, there were 77 (53.8 %) patients had right side and there were 66 (46.2 %) had left side.

In our study, we found that the mean number of dislocations was 4.90± 1.94 and ranged from two to 9.

In consistent with our results, Marquardt B et al.,[12] who aimed to prospectively evaluate the surgical outcome of arthroscopic Bankart repair via suture anchors in patients with recurrent traumatic anterior shoulder instability with a minimum follow-up of 2 years. They found that the average number of dislocations at 5.5, before the patients underwent surgery.

In our study, we reported that the mean Pre-operative Rowe score was 60.43 ± 10.25 and ranged from 39 to 78.

In consistent with our results, Gasparini G et al, [11] they found that in patients with traumatic anterior shoulder instability, total Preoperative Rowe score was 25 (5–55).

Also, de Campos Azevedo et al., [13] they found that in patients who underwent Dynamic Anterior Stabilization with Biceps Transfer for the Treatment of Anterior Glenohumeral Instability, Preoperative Mean Rowe score was 16.00 ±14.66.

In our findings, the mean post-operative Rowe score was 82.0± 6.71 and ranged from 65 to 91.

In supporting our results, Gasparini G et al, [11] they revealed that in patients with traumatic anterior shoulder instability, total Postoperative Rowe score was 100 (40–100).

Also, Silva LA et al.,[14] they reported that in patients with anterior recurrent dislocation of the shoulder, the scores of Rowe were 90.6 (range: 30–100) in the postoperative period.

As well, de Campos Azevedo et al., [13] they found that in patients who underwent Dynamic Anterior Stabilization with Biceps Transfer for the Treatment of Anterior Glenohumeral Instability, 12-Month Mean Rowe score was 88.67 ± 21.42.

Moreover, Das A et al.,[15] they found that in patients who underwent arthroscopic Bankart repair for post-traumatic recurrent anterior shoulder dislocation, the total post-operatively Rowe score of a mean and standard deviation (SD) was 94.20 ± 15.92.

Furthermore, Marquardt B et al., [12] they reported that in patients with recurrent traumatic anterior shoulder instability with a minimum follow-up of 2 years, the mean post-operative Rowe score was 92.1 points (SD, 19.1 points).

In our study, we found that there was a significant difference between pre-operative and post-operative Rowe score ($p<0.001$) as Rowe score was significantly increased postoperatively compared to preoperatively.

In consistent with our results, Parmar RS et al., [10] they found that there were no significant differences in Rowe total score before surgery and at 3-month follow-up, but after 6 months there was a steady and significant improvement up to the 2nd year.

In our study, as regard relation between post-operative Rowe score and gender, there was no significant difference between males and females regarding post-operative Rowe score ($p=0.750$).

In supporting our results, Parmar RS et al., [10] they found in patients who have a history of traumatic recurrent shoulder joint dislocation that there was no significant relationship between post-operative Rowe scores with side of dislocations.

Limitation

No long-term follow-up of functional recovery and shoulder functions. Good knowledge of shoulder anatomy and skills in arthroscopy are needed. Weaker sling when compared to Latarjet. No bony restoration of glenoid arc is done.

Conclusion

This study clinically evaluated the effectiveness of trans-subscapular transposition of the long head of the biceps (LHB) as a dynamic sling for treating recurrent shoulder instability. The results suggest that this procedure is a viable option for managing glenoid bone loss up to 20% without off-track Hill-Sachs lesions. The fixation of the LHB tendon to the glenoid with 2-3 anchors (3 mm) provided strong fixation with minimal soft tissue dissection. The procedure can be used for both labral reconstruction (in cases of irreparable labrum) and labral augmentation (in cases of repairable labrum), showing promising clinical outcomes with low recurrence rates.

Recommendation

This technique should be investigated in biomechanical and cohort clinical studies to clarify its long-term validity.

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