Functional outcomes of arthroscopic frozen shoulder release in diabetic and nondiabetic patients: a comparative study

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Received: 27-May-2024
Revised: 20-Jun-2024
Accepted: 13-Jul-2024
Published: 13-Sep-2024

The Egyptian Orthopaedic Journal 2024, 59:306–310

Background
Adhesive capsulitis (Frozen shoulder) is a disorder that remains poorly understood in terms of pathology and optimal treatment. Frozen shoulder is common among diabetic patients, with diabetes being a significant risk factor. This study evaluated the shoulder function (utilizing Oxford score and range of motion) and visual analogue scale (VAS) pain score after performing arthroscopic 360° capsular release and biceps tenotomy in diabetics versus nondiabetics with primary frozen shoulder.

Patient and methods
This prospective comparative analysis was conducted at Ain Shams University Hospitals between September 2022 and September 2023. Twenty patients with an established diagnosis of idiopathic frozen shoulder, with symptoms for a minimum of three months and failed conservative management were enrolled. All patients underwent arthroscopic 360° capsular release and biceps tenotomy with at least a 6-month follow-up period. Clinical, and functional data (Oxford Shoulder Score and range of motion), VAS pain score, and perioperative data were recorded and analyzed.

Results
The study population included 15 (75%) females and five (25%) males, they were divided into two age and sex-matched groups, 10 patients diagnosed with diabetes in group 1 and 10 nondiabetic patients in group 2, with a mean age of 53 years in group 1 and 48 years in group 2. Both groups demonstrated significant postoperative improvement in VAS pain score, Oxford shoulder score, and range of motion with a *P* value less than 0.001. When comparing the magnitude of benefit between the two groups, no statistically significant difference was detected (*P* value $^{>}$ 0.05).

Conclusion
Arthroscopic 360° capsular release and biceps tenotomy effectively lower VAS pain score and improve shoulder function and range of motion in idiopathic frozen shoulder. Both nondiabetic patients and diabetic benefit equally from the procedure.

Keywords:
adhesive capsulitis, arthroscopic 360° release capsular, biceps tenotomy, diabetes mellitus, frozen shoulder

Egypt Orthop J 2024, 59:306–310

1110-1148

Introduction

Frozen shoulder commonly termed adhesive capsulitis (AC) is a disorder that causes inflammation in the capsule of the glenohumeral joint leading to extensive scar tissue and adhesions [1]. It is associated with comorbidities such as diabetes mellitus (DM) and hypo- and hyperthyroidism [2,3]. AC is five times more prevalent in diabetics; moreover, patients with type 2 DM are 3 times more prone to develop AC than type 1 DM [4]. The prevalence of AC in diabetics is 13.4%, while 30% of patients with DM had AC, making it the most common musculoskeletal disorder of the upper limb in diabetics [5,6]. Frozen shoulder patients with DM are younger, with incidence directly proportional to the duration of DM and poor glycemic control [3,6]. The clinical presentation includes progressive limitation of shoulder movement (active and passive) and gradual onset of pain [7]. Plain radiographs are usually unremarkable, while MRI often shows specific signs such as the thickening of Coraco-humeral and inferior glenohumeral ligaments [8]. Treatment options range from anti-inflammatory nonsteroidal drugs, corticosteroid injections [9], ultrasound-guided hydro-dilatation [10], hyaluronic acid injections [11], Calcitonin therapy [12], extracorporeal shock wave

therapy [13], manipulation under general anesthesia and capsular release. However, arthroscopic release is still the primary treatment for resistant cases following unsuccessful conservative treatment, with significant long-term effectiveness [14,15]. This study compared shoulder function, range of motion (ROM), and pain of arthroscopic 360° capsular release and biceps tenotomy in diabetics versus nondiabetics with primary frozen shoulder.

Patients and methods

We conducted this prospective comparison research at Ain Shams University hospitals between September 2022 and September 2023 to assess the arthroscopic 360° capsular release results in 20 patients. We included patients diagnosed with idiopathic AC aged between 30 and 70 years with symptoms for at least 3 months, who had failed conservative treatment (NSAIDs and physiotherapy). Next, groups of patients were created: those with DM (group 1) and those without (group 2). We Excluded patients with shoulder osteoarthritis, rotator cuff pathology, prior incidence of proximal end humerus fractures, previous shoulder surgery, and recurrent cases after previous operative intervention. All patients underwent a comprehensive evaluation and clinical examination including a modified Oxford Shoulder Score (mOSS), visual analogue scale (VAS) for pain, and ROM. To rule out any intraarticular pathology and to confirm the diagnosis, all patients received plain radiographs and shoulder MRIs. For all patients, we conducted arthroscopic 360 capsular release, rotator interval (RI) release and biceps tenotomy as described by Lafosse *et al*. [16]. Approval from the Research and Ethics Committee of Ain Shams University (FWA000017585 approval FMASU MS 664/2/2/2/2) was obtained.

Surgical technique

A beach chair posture was used, and general anesthesia was administered to each patient. The shoulder range of motion was measured. The patient's arm was then prepared and draped. Posterior and anterior portals were then created. Using a radiofrequency wand, all patients had biceps tenotomies, and the anterior and posterior capsules released 360º. Lastly, patients were examined for shoulder ROM to ensure adequate release. All patients were subjected to Immediate supervised ROM on day one. A home exercise program was explained, and physiotherapy sessions were ordered for patients upon discharge.

Evaluation

Patients were evaluated pre and postoperatively after 3 weeks, 6 weeks, 3 months, and 6 months. The demographic data was collected, and the evaluation of ROM was done by measuring individual shoulder ROMs (forward flexion (FF), abduction external rotation (ER), and internal rotation (IR)) using a goniometer. The functional and pain evaluations were recorded using the mOSS and VAS.

Statistical analysis

Using the SPSS Statistics program, the mean, standard deviation, student *t*-test, χ^2, and Paired *t*-test were employed in the statistical analysis of this study. (IBM Corp., Armonk, NY, USA; Version 26-2018). *P* values below 0.05 were considered significant, *P* values above 0.05 were considered nonsignificant, and highly significant when below 0.01.

Results

Twenty patients with idiopathic AC were included in this prospective comparative research; they were enrolled in the outpatient clinics of the hospitals affiliated with Ain Shams University. We divided the cohort into group 1 (10 diabetic patients) and group 2 (10 nondiabetic patients).

Patient demographics

The study population age ranged between 30 and 70 years, with a mean age of 53 years in the diabetic group and 48 years in the nondiabetic. They included 15 (75%) females and five (25%) males. The mean period of symptoms was 10 months for diabetics and 14 months for the nondiabetics group. The two groups were matched for age, sex, laterality, and duration of symptoms.

Functional outcome, pain evaluation and glenohumeral (GH) ROM

Both diabetic and non-diabetic groups were matched at baseline regarding mOSS and VAS pain scores (*P* value 0.716 and 0.396, respectively). There was statistically significant improvement involving the mOSS and VAS pain scores between the baseline and the 6-month follow-up (*P* value < 0.001) in both groups. There was no statistically significant difference in mOSS and VAS pain scores at the final postoperative follow-up (*P* value 0.063 and 0.874, respectively)—Tables 1 and 2.

At baseline, diabetics had significantly worse ER, abduction, and internal rotation. (*P* value 0.006, 0.001, and 0.001, respectively). However, between the baseline and the 6-month follow-up, both groups' shoulder range of motion significantly improved. (*P* value < 0.001).

We couldn't detect any statistically significant difference in FF, IR, and abduction at the final

Table 1 Comparison between and within the diabetic group and the nondiabetic group pre and postoperatively regarding Oxford score

Oxford score	Group		*T*-Test	
	Diabetics	Nondiabetics	t	*P* value
Preoperative				
Range	5–25	6–24	−0.369	0.716
Mean±SD	13.800±9.114	15.100±6.385		
Postoperative				
Range	25–45	31–42	−1.985	0.063
Mean±SD	33.700±6.601	38.600±4.169		
Differences				
Mean±SD	−19.900±7.475	−23.500±8.250	1.023	0.320
Paired Test				
P value	<0.001*	<0.001*		

Table 2 Comparison between and within the diabetic group and the nondiabetic group pre and postoperatively regarding visual analogue scale pain score

VAS score	Group		*T*-Test	
	Diabetics	Nondiabetics	t	*P* value
Preoperative				
Range	6–10	6–9	0.870	0.396
Mean±SD	8.300±1.337	7.800±1.229		
Postoperative				
Range	1–4	1–6	0.161	0.874
Mean±SD	2.600±0.966	2.500±1.716		
Differences				
Mean±SD	5.700±1.636	5.300±1.947	0.497	0.625
Paired Test				
P value	<0.001*	<0.001*		

postoperative follow-up (*P* value 0.175, 0.063, and 0.874, respectively) in both groups. However, diabetics showed a significantly lower ER range at the final postoperative follow-up, with a *P* value of 0.01, and a mean postoperative ER range of 73°±6.77 in group 1 and 80.5°±5.503 in group 2. Table 3.

In terms of the two groups' respective levels of improvement in mOSS, VAS pain score, and ROM, we did not find a discernible statistically significant change. (*P* value > 0.05). as shown in Tables 1–3.

Discussion

AC is common in the diabetic population, and individuals with DM typically experience worse outcomes as regards functional outcome, shoulder motion, and pain [17–21].

Numerous recent studies have demonstrated the remarkable impacts of arthroscopic capsular release (ACR) on pain reduction and range of motion improvement. According to Le Lievre and Murrell [15], these benefits were sustained for seven years. Furthermore, ACR was superior in clinical outcomes to other procedures [22]. Several studies have examined the various results of ACR in frozen shoulders among diabetic and non-diabetic individuals. However, Neviaser pointed out that differences in intervention techniques, inconsistent reporting of outcomes, small study populations, and a lack of categorization and comparison have resulted in conflicting literature [7].

Thus, in this study, we aimed to standardize the approach to all our patients regarding pre, postoperative ROM assessment, surgical technique, and functional outcome assessment to prevent different and contradicting outcomes that can render our results irreproducible.

In this study, both groups showed significant postoperative improvement in VAS pain score, mOSS, and shoulder motion with a *P* value less than 0.001. When comparing the two groups as regards the degree of improvement, no difference of statistical significance was detected (*P* value > 0.05).

Additionally, no statistically significant difference between the two groups in the postoperative functional outcomes, pain relief, and ROM except in ER. However, patients did not notice it functionally and it did not affect their daily activities.

Reviewing the relevant literature, we concluded the following.

Our results coincide with that of Tawfeek *et al.* [23]; who studied 32 patients with frozen shoulders 19 diabetics and 13 nondiabetics however, the authors reported improvement only in scores (UCLA, VAS) without recording ROM.

Mehta *et al.* [21] reported that pain values were zero in four patients from the nondiabetic group after 6 months and 19 patients after 24 months. In the diabetic group, none of the patients conveyed zero pain values after 6 months, but 14 patients reported zero pain values after 24 months. Those results were not replicated in our study, except in and nondiabetic patient. The study also concluded that diabetics had worse functional scores and ROM evaluation at 6 months, a result that differs from our study.

In Lyhne *et al.* [24] study, surgical intervention was not unified in all patients. Posterior capsular release was done 'only when needed'. Still, we had similar results in pain, function, and ROM to their study.

Cinar *et al.* [18] studied 26 patients with frozen shoulders unresponsive to conservative treatment.

Table 3 Comparison between and within the diabetic group and the nondiabetic group pre and postoperatively regarding shoulder range of motion

Forward flexion	Group		*T*-Test	
	Diabetics	Non-diabetics	t	*P* value
Preoperative				
Range	45–90	40–70	0.505	0.620
Mean±SD	58.500 ± 16.168	55.500 ± 9.560		
Postoperative				
Range	100–170	120–170	–1.413	0.175
Mean±SD	142.500 ± 19.039	153.000 ± 13.784		
Differences				
Mean±SD	–84.000 ± 32.128	–97.500 ± 20.035	1.128	0.274
Paired Test				
P value	<0.001*	<0.001*		
External rotation	Diabetics	Nondiabetics	t	*P* value
Preoperative				
Range	20–30	20–50	–3.087	0.006*
Mean±SD	27.500 ± 3.536	36.500 ± 8.515		
Postoperative				
Range	60–80	75–90	–2.900	0.010*
Mean±SD	72.500 ± 6.770	80.500 ± 5.503		
Differences				
Mean±SD	–45.000 ± 5.270	–44.000 ± 9.369	–0.294	–0.772
Paired Test				
P value	<0.001*	<0.001*		
Abduction	Diabetics	Nondiabetics	t	*P* value
Preoperative				
Range	30–60	50–70	–3.845	0.001*
Mean±SD	43.000 ± 10.055	58.500 ± 7.835		
Postoperative				
Range	50–170	140–170	–1.981	0.063
Mean±SD	136.500 ± 33.834	158.500 ± 9.443		
Differences				
Mean±SD	–93.500 ± 33.587	–100.000 ± 13.333	0.569	0.577
Paired Test				
P-value	<0.001*	<0.001*		
Internal rotation	Diabetics	Non-Diabetics	t	*P* value
Preoperative				
Range	20–30	30–45	–4.437	<0.001*
Mean±SD	26.000 ± 4.595	35.500 ± 4.972		
Postoperative				
Range	30–70	35–70	–0.107	0.916
Mean±SD	55.500 ± 11.168	56.000 ± 9.661		
Differences				
Mean±SD	–29.500 ± 9.560	–20.500 ± 11.655	–1.888	0.075
Paired Test				
P value	<0.001*	<0.001*		

They stated worse outcomes in diabetics compared with nondiabetics as regards ROM, functional score, and pain relief. Significant differences in IR and abduction between both groups were reported. They attributed this to the use of different ROM parameters and scores.

Yanlei *et al*. [25] showed that while both groups significantly improved in range of motion and decreased pain scores, diabetics' improvements in IR and FF were less pronounced. They referred to inadequate release of the inferior capsule in diabetics due to fear of axillary nerve injury.

The role of biceps tenotomy with arthroscopic 360 release is still unclear and not done universally in all studies. Lafosse *et al*. [16] utilized biceps tenotomy with arthroscopic 360 release. Their study was done on 10 patients with excellent results. However, it lacks a comparison based on DM status.

Conclusion

Arthroscopic 360˚ capsular release and biceps tenotomy effectively lower VAS pain score and improve shoulder function and range of motion in idiopathic frozen shoulder. Both nondiabetics and diabetics benefit equally from the procedure.

Ethical Approval

Approval from the Research and Ethics Committee of Ain Shams University (FWA000017585 approval FMASU MS 664/2/2/2/2) was obtained.

Informed Consent

Informed consent was obtained from all patients before surgery.

Authors contributions

AA and YH: conceptualization, methodology; HED and ME: writing original draft; HED and YH: visualization, investigation; AA: supervision; YH and ME: writing, reviewing, and editing.

Financial support and sposnorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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