Frozen shoulder: is arthroscopy required after manipulation under general anesthesia

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Background
Frozen shoulder is a common problem in middle-aged men and women, especially in diabetic patients. It is characterized by the gradual development of overall limitation in active and passive shoulder motion. If conservative treatment, local injection, and physiotherapy have failed with these patients, arthroscopic capsular release or manipulation under general anesthesia (MUA), or both is indicated. In this work, the difference between performing arthroscopic release after MUA and manipulation alone is studied.

Patients and methods
A randomized prospective controlled study enrolled 43 consecutive patients who were diagnosed as having a frozen shoulder. There were 25 right shoulders and 18 left shoulders, treated in 29 women and 14 men. The mean age of the patients at the time of surgery was 51 years (range 40–62 years). The patients were divided randomly into two groups. The first group included 21 patients in whom arthroscopy was carried out after MUA. The second group included 22 patients in whom MUA only was carried out and served as a control group. The shoulder range of motion (ROM) values were recorded before and after the procedure, as well as the constant score. The mean follow-up period was 16 months for the patients (range 12–20 months).

Results
Statistically, there was no difference in the demographic data between the two groups. In the first group in which arthroscopy was used, three patients (14.3%) were unsatisfied because of the persistence of pain and recurrence of symptoms and 18 patients (85.7%) were satisfied overall in terms of pain and improvement in ROM. In the second group, four patients (18.2%) were unsatisfied and 18 patients (81.8%) were satisfied after the procedure. In group 1, the mean preoperative constant score was 15 ± 4, which improved significantly to 70 ± 21 ($P < 0.001$) in the last follow-up. In group 2, the mean preoperative constant score was 15 ± 3.7. This improved significantly to 64 ± 20 ($P < 0.001$) in the last follow-up. There was no significant difference in the postoperative constant score groups ($P = 0.3$). There were also no significant difference in abduction ($P = 0.9$), flexion ($P = 0.8$), or external rotation ($P = 0.5$) between the two groups.

Conclusion
At the last follow-up, the percentage of recurrence was slightly higher in the second group, who had only MUA, but there was no statistical difference between both the groups in terms of pain, ROM, and constant score. However, arthroscopy may lead to more technical difficulty and more risk of longer anesthesia time.

Keywords:
arthroscopy, frozen shoulder, manipulation under anesthesia

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Introduction

Both frozen shoulder and adhesive capsulitis are generic terms for a common disorder of the shoulder affecting the glenohumeral range of motion (ROM) [1]. Codman's original description of the clinical picture of frozen shoulder is still considered to be the most accurate [2]. He described the features of a frozen shoulder as slow-onset shoulder pain, localized discomfort near the deltoid insertion, an inability to sleep on the affected side, restricted glenohumeral elevation, and external rotation, and a normal radiological appearance [3].

It is a common problem in middle-aged men and women, especially in diabetic patients, in whom the incidence is between 10.8 and 36%, whereas in the general population, it is between 2.3 and 5% [4,5]. Frozen shoulder is classified as primary when it is idiopathic and secondary when it is associated with diabetes mellitus, cervical radiculopathy, and subacromial impingement syndrome.

However, shoulder stiffness is the term used to describe the condition of post-traumatic affection of motion of the shoulder joint [6]. In this study, the definition of frozen shoulder by the American shoulder and elbow surgeons was adapted. They define the frozen shoulder as a condition of varying severity characterized by the gradual development of overall limitation of active and passive shoulder motion where radiographic findings other than osteopenia are absent [7].

Manipulation under general anesthesia (MUA) is a well-established method for the treatment of a frozen shoulder when the conservative treatments by anti-inflammatory drugs, analgesics, and physiotherapy have failed [8,9].

Several surgeons suggest arthroscopic capsular release for more controlled capsular release and to avoid the risks of MUA [3,10,11].

Other surgeons add arthroscopic capsular release to the MUA [1,12]. These authors recommend performing the arthroscopic procedure in diabetic patients [13].

To our knowledge, other than diabetes mellitus, and recurrence after MUA, no definitive parameters exist to guide the surgeon about who will require additional arthroscopic capsular release for MUA in order to achieve the best results.

In these randomized-controlled clinical observations, patients' satisfaction and statistical analysis will be depended on to assess the results of adding arthroscopy after MUA.

Patients and methods

This randomized prospective controlled study enrolled 43 consecutive patients who were diagnosed with a frozen shoulder according to Codman's criteria. Between June 2006 and February 2009, these 43 patients had failed medical treatment, steroid injection, and physiotherapy for 3–6 months and were eligible for the procedure. The patients were randomly divided into two groups. The first group included 21 patients in whom arthroscopy was carried out after MUA. The second group included 22 patients in whom MUA only was carried out and served as a control group.

There were 25 right shoulders and 18 left shoulders, treated in 29 women and 14 men. The mean age of the patients at the time of surgery was 51 years (range 40–62 years). There were 23 diabetic patients; 13 patients were in group 1 and 10 patients were in group 2.

In this study, the surgical indication was limitation of ROM in all directions, especially external rotation at 0 and 90°of abduction (ER_0 and ER_{90}).

Exclusive criteria were patients with shoulder stiffness as defined in the introduction. All patients were subjected to a standardized history and physical examination, and underwent preoperative radiography and MRI. The severity of pain was recorded preoperatively and post-operatively by a visual analogue scale from 1 to 10, where 10 is the most severe pain. Overall patient satisfaction was also measured and graded on a scale of 1–10 points [14]. The shoulder ROM values were recorded before and after the procedure. While the patients were seated, abduction, flexion, ER_0, ER_{90}, and internal rotation at 90° abduction (IR_{90}) were measured in degrees using a goniometer. Internal rotation at 0° abduction (IR_0) was graded and measured. The constant score [15,16] was also calculated before and after the procedure. The mean follow-up period was 16 months for the patients (range 12–20 months).

Data were analyzed using SPSS software (SPSS Inc., Chicago, Illinois, USA). Statistical analysis was performed using the paired *t*-student test and the one-way analysis of variance test.

Techniques

Under general anesthesia, all the patients underwent manipulation while in the supine position. The arm was grasped above the elbow. The manipulation was carried out gently by forward flexion, abduction, and external rotation, then internal rotation in 90°, and then maximum forward flexion until the arm was returned by the side of the patients. The mobilization was carried out gently with a smooth movement and was repeated two to three times to ensure efficient manipulation. In group 1, the operation table was elevated to the beach chair position and after regular antiseptic draping, the patients underwent standard glenohumeral arthroscopy through posterior portal while using the anterior portal for instruments, and then alternatively, the scope was introduced from the anterior portal to visualize the posterior capsule and the posterior portal was used for the instruments. Typically, abundant angiogenesis was found, especially in the rotator interval area with generalized synovitis. A unipolar diathermy Prob (Mitec VAPR; Ethicon Inc., Somerville, New Jersy, USA) was introduced into the joint, and coagulation of the bloody edges of the capsule was carried out in the torn areas while completing the capsular release near the labrum where there were no tears whether in anterior or posterior capsules. No attempt was made to divide the inferior capsule with diathermy to avoid the axillary nerve.

The arthroscopic completion of capsular release after the manipulation was required in the anterior capsules in two patients (9.5%) and was done in the posterior capsule in six patients (28.5%), whereas the rest of the patients (13 cases) of group 1 did not require further capsular release. The joint was washed out and the portal was sutured with suction, which was removed after 24 h. In group 2, the MUA was the only procedure that was carried out. All the joints in both groups were injected with 10 ml of 0.5% bupivacaine and 25 mg hydrocortisone acetate, and the arm was rested in a broad arm sling for 24 h. The after-treatment protocol consisted of physiotherapy for a mean of 13 weeks (range 6–20 weeks). All the patients were clinically examined at 3, 6 weeks, 6, and 12 months of follow up and the data were documented. The constant score was calculated after the 6-week, 6-, and 12-month visits.

Results

Statistically, there was no difference in the demographic data between the two groups in terms of age, sex, etiology preoperative ROM, and duration of preoperative symptoms. Of the first group of patients, 12 patients (57.1%) experienced a marked improvement in terms of pain and 14 patients (66.7%) experienced improvement in functional gain in the first 2 weeks. In the second group, in whom only MUA was carried out, only seven patients (31.8%) experienced improvement in pain, but 15 patients (68.2%) experienced improvement in terms of functional gain in the first 2 weeks. In the first group in which arthroscopy was used, three patients (14.3%) were unsatisfied because of the persistence of pain and recurrence of symptoms and 18 patients (85.7%) were overall satisfied in terms of pain and improvement in ROM. In the second group, four patients (18.2%) were unsatisfied and 18 patients (81.8%) were satisfied after the procedure. The mean satisfaction score was 7 out of 10 points postoperatively for both groups. At the last follow-up, the visual analogue scale score, ROM, and constant score had significantly ($P<0.001$) improved in both groups as shown in Table 1.

The mean gain in all patients was 96° in abduction, 95° in flexion, 45° in ER_0, 42° in ER_{90}, 32° in IR_{90}, and 31° in IR_0.

In group 1, the mean preoperative constant score was 15 ± 4, which improved significantly to 70 ± 21 ($P< 0.001$) in the last follow-up. In group 2, the mean preoperative constant score was 15 ± 3.7. This improved significantly to 64 ± 20 ($P<0.001$) in the last follow-up. There was no significant difference in the postoperative constant score groups ($P = 0.3$). There were also no significant differences in abduction ($P = 0.9$), flexion ($P = 0.8$), or external rotation ($P = 0.5$) between the two groups. No postoperative complications of infection, instability, axillary nerve injury, or fractures were observed in any of the patients. Shoulder pain was alleviated after treatment in both groups within the first 6 weeks and it decreased further after physiotherapy and over time as shown in Table 2. There was an observation that in the first few days period after the procedure the pain in group 2 without arthroscopy was much more than the pain in group 1 who had arthroscopy after MUA. The mean movements of abduction, flexion, ER_{90}, ER_0, IR_{90}, and IR_0 improved significantly ($P<0.05$) from the preoperative range to the postoperative range in both groups. However, there was no significant difference between both groups (Table 3). Although the shoulder achieved full ROM during the procedures, ROM decreased in the first few weeks after treatment and, by the end of 6 weeks postoperatively, recurred with physiotherapy and exercises. The mean angles of ROM decreased insignificantly ($P = 0.8$) after 6–12 months postoperatively in both groups because of the recurrence of the condition in some cases. Recurrence of limitation of ROM and pain occurred in three patients of group 1 (14.3%), and these patients were diabetic; only patient was nondiabetic and she was from group 2.

Discussion

The pathology of adhesive capsulitis has been recognized as the deposition of scar tissue in the shoulder joint capsule. The logic is to release this capsular contracture whether by MUA or by arthroscopy [4,17].

Overall, all the patients in this study experienced rapid, significant improvement in pain, range of movement, and

Table 1 Summary of visual analogue scale, range of motion, and constant score in both groups preoperatively and at 12 months postoperatively

	VAS		Abduction		Flexion		ER_0		ER_{90}		IR_0		IR_{90}		CS	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Group 1 with arthroscopy	8.3	2.6	53	149	60	156	11	60	9	52	28	61	17	53	15	70
Group 2 without arthroscopy	8.5	2.6	52	148	60	154	10	52	9	50	21	51	15	44	15	64

CS, constant score; ER_0, external rotation at 0° abduction; ER_{90}, external rotation at 90° abduction; IR_0, internal rotation at 0° abduction; IR_{90}, internal rotation at 90° abduction; ROM, range of motion; VAS, visual analogue scale.

Table 2 Postoperative visual analogue scale pain score in both groups

VAS	Preoperative	6 weeks postoperatively	6 months postoperatively	12 months postoperatively	*P* value between preoperative and 6 weeks	*P* value between preoperative and 12 months	*P* value between 6 weeks and12 months	*P* value between 6 and 12 months
Group 1 with arthroscopy	8.3 ± 0.8	3 ± 1.6	2.8 ± 1.8	2.6 ± 2.5	<0.001	<0.001	0.45	0.47
Group 2 without arthroscopy	8.5 ± 0.7	3.2 ± 1.5	2.8 ± 2	2.6 ± 3	<0.001	<0.001	0.48	0.49

VAS, visual analogue scale.

Table 3 Postoperative results of range of motion in both groups

	Abduction				Flexion				ER_0				ER_{90}				IR_0				IR_{90}			
	Pre	6 w	6 m	12 m	Pre	6 w	6 m	12 m	Pre	6 w	6 m	12 m	Pre	6 w	6 m	12 m	Pre	6 w	6 m	12 m	Pre	6 w	6 m	12 m
Group 1	53 ± 9	158 ± 22	149 ± 31	149 ± 32	60 ± 10	163 ± 20	160 ± 30	156 ± 32	11 ± 9	67 ± 14	62 ± 20	60 ± 23	9 ± 8	63 ± 14	60 ± 18	52 ± 22	28 ± 10	65 ± 12	62 ± 16	61 ± 18	17 ± 7	56 ± 9	54 ± 12	53 ± 14
Group 2	52 ± 9	151 ± 25	150 ± 30	148 ± 30	60 ± 11	163 ± 20	156 ± 32	154 ± 34	10 ± 7	62 ± 8	58 ± 14	52 ± 17	9 ± 7	57 ± 10	53 ± 15	50 ± 18	21 ± 7	57 ± 13	54 ± 15	51 ± 17	15 ± 6	51 ± 11	47 ± 16	44 ± 18

ER_0, external rotation at 0° abduction; ER_{90}, external rotation at 90° abduction; IR_0, internal rotation at 0° abduction; IR_{90}, internal rotation at 90° abduction; m, months; w, weeks.

constant score in the early postoperative period. At the last follow-up, the percentage of recurrence was slightly higher in the second group, which had only undergone MUA, but there was no statistical difference between both groups in terms of the pain, ROM, and constant score. In this study, there were significant improvements in function and overall satisfaction of the patient, although the mean constant scores postoperatively were 70 and 64, which are lower than expected. However, these scores have not been adjusted with respect to the power of the opposite arm, age, or sex. The mean abduction and flexion in both groups approached the normal range more than external rotation and this may be attributed to the failure of both procedures to resect the coracohumeral ligament, which is extra-articular. However, this had little impact on the patients' satisfaction because they regained most of the abduction range.

There has been considerable progress in the treatment of a frozen shoulder since the dogmatic concept of that the condition always gets better in 2 years which was claimed to be Codman's statement. This led several surgeons to treat it conservatively, to the extent that in 1959 Prof. Sir John Charnly found that 70% of his colleagues in the British Orthopedic Association refused the idea of MUA in the treatment of a frozen shoulder, but in a series of 35 patients, he found that it led to no adverse outcomes, the pain was eased, and by 10 weeks, the patients were free from symptoms [18]. In a more recent study, Andersen *et al.* [1] have shown that 79% of patients with a frozen shoulder are relieved of their pain and 75% regain an almost normal ROM after manipulation. Most of the recent studies are in favor of arthroscopic capsular release [19,20], and Bunker [11] reported that the use of the arthroscope allows capsular release with great finesse.

However, he also reported that MUA remains the most popular treatment for a frozen shoulder among orthopedic surgeons. The debate is still ongoing in the literature between those who are in support of MUA and those who are in support of arthroscopic capsular release. In this study, arthroscopic completion of release did not contribute to significant improvement in pain, ROM, or function of the patients. None of the complications of MUA such as fracture of surgical neck [21], dislocation [22], or lesions of the rotator cuff or the long head of biceps [23] occurred. However, the addition of arthroscopy increased the technical difficulty, duration of anesthesia, and the risk of infection. The recurrence rate in this study was higher in the diabetic patients. However, there was not much difference between both the groups. The limitation of this study is the small number of patients, but the inclusion criteria were restricted to patients with a primary frozen shoulder, and other cases of shoulder stiffness were not included. Another limitation is the short follow-up period, but this is a condition that does not recur once it has healed; thus, it is unlikely that the results would deteriorate with time [3].

Conclusion

In this study, performing arthroscopic capsular release after MUA did not contribute toward a statistically significant improvement in the ROM, pain, or function of the shoulder in the treatment of a frozen shoulder. However, it may contribute to more technical difficulty and greater risk of infection and a longer duration of anesthesia.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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