Comparison of idiopathic, post-trauma and post-surgery frozen shoulder after manipulation under anaesthesia

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Abstract Manipulation under anaesthesia (MUA) has been used to speed the recovery of frozen shoulder, which is said to be a self-limiting process. We wished to assess the short- and long-term results of the treatment of frozen shoulders by manipulation under anaesthesia and compare the results between idiopathic, post-injury and post-operative frozen shoulders. We applied an adjusted Constant score (Constant score after excluding the 25 points allocated for the assessment of muscle strength) to assess all patients. In our series, 47 cases with 51 frozen shoulders were collected and evaluated retrospectively. The adjusted Constant score before manipulation was on average 22.8 ± 4.9 (10–31) points. The score from the 3-week follow-up was 52.6 ± 9.2 (31–67) points on average. The score from the 82-month follow-up was on average 70.1 ± 6.2 (54–75) points, with 23 shoulders scored for a maximum point number of 75. The score at the early and late follow-ups was significantly lower for the post-operative group (63.2 ± 6.7) when compared to the other two groups ($P < 0.001$). Our results revealed that manipulation under anaesthesia is a very simple and non-invasive procedure for reducing the course of an apparently self-limiting disease and can improve shoulder function and symptoms quickly. However, we found less improvement in post-operative frozen shoulders, especially with regard to residual pain and limited range of motion (ROM), which may be influenced by the initial

injury or initial operation. Although less improvement in pain and ROM was noted, manipulation is still a good and simple way to treat post-operative frozen shoulders.

Résumé La manipulation sous anesthésie est utilisée pour hâter la récupération des épaules gelées qui sont considérées comme un processus d'auto-limitation. Nous avons étudié les résultats à court et long terme de ces manipulations en comparant les résultats des épaules gelées idiopathiques, post-traumatiques et post-chirurgicales avec un score de Constant modifié (en excluant les 25 points alloués à la force musculaire). Nous avons évalué rétrospectivement 51 épaules gelées chez 47 patients. Le score de Constant modifié était avant la manipulation de $22,8 \pm 4,9$ (10–31). Le score à 3 semaines était de $52,6 \pm 9,2$ (31–67). Le score à 82 mois de recul moyen était de $70,1 \pm 6,2$ (54–75), avec 23 épaules au score maximum de 75 points. Le score au recul précoce et tardif était significativement plus faible dans le groupe post-chirurgie ($63,2 \pm 6,7$) que dans les autres groupes ($P < 0,001$). Nos résultats montrent que la manipulation sous anesthésie est une méthode non invasive efficace pour améliorer rapidement la fonction de l'épaule. Il y a moins d'amélioration dans les cas post-chirurgicaux notamment au niveau des douleurs résiduelles et de l'amplitude de mobilité mais la manipulation reste quand même un bon traitement dans ces cas.

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Introduction

Adhesive capsulitis of the shoulder (frozen shoulder) is characterised by a gradual increase in stiffness and pain. This self-limiting disorder has three stages lasting up to 1 to

3 years [9, 20] and does not re-occur in the same shoulder [8]. However, it can sometimes result in a minor contracture [2]. Its aetiology is still unknown, and many treatment regimens, including conservative treatment, nerve blocks and distension, manipulation under anaesthesia and open or arthroscopic release, with or without MUA, have been used to hasten the recovery time [7, 10, 14, 18, 21, 23]. However, the benefit has yet to be determined [1].

Excellent results of manipulation under anaesthesia have been reported by many authors [6, 11, 13, 14, 17], but only a few have focused on the secondary frozen shoulder [11, 13]. In our study, we tried to assess the short- and long-term results of frozen shoulders after manipulation under anaesthesia and to compare the results of idiopathic, post-injury and post-operative frozen shoulders.

Materials and methods

Selection of patients

We adopted the criteria described by Shaffer et al. for the diagnosis of frozen shoulders [22]. It consisted of (1) at least a 1-month history of pain and stiffness of the shoulder; (2) documented restriction of both passive and active glenohumeral and scapulo-thoracic motion of equal or less than 100 degrees of abduction, and less than 50% of external rotation, as compared to the contralateral side; (3) the intra-operative characteristic feeling of tissue breakdown during manipulation. The patients were managed conservatively with medications and stretching techniques first, with manipulation at 3 months if pain and loss of motion were reported. Between 1992 and 2003, 251 patients with frozen shoulders were treated in our hospital. In this study, patients were excluded if they had (1) a history of cancer, diabetes or rheumatic disease, (2) rotator cuff tear or residual tear after repair, (3) recent fracture, (4) severe neurological deficit of the involved upper extremity, (5) loss of follow-ups or incomplete preoperative data and (6) a range of motion <80% was regained. After selection, 47 cases with 51 frozen shoulders were collected and evaluated retrospectively. Fifty-one shoulders were separated into three groups according to the system of Zuckerman et al. [24]. Twenty-six shoulders were classified as an idiopathic group as there was no significant trauma to the shoulder prior to the onset of symptoms. Twelve patients were classified as the after-trauma group (under non-operative treatment). The remaining 13 patients were classified as the after-surgery group. In the after-trauma group, six had proximal humeral undisplaced fracture, three had distal clavicle undisplaced fracture, one had an acromio-clavicular injury (type III) and two had glenoid undisplaced fracture. In the after-surgery

group, eight patients had open repair for rotator cuff tear, two had proximal humeral fracture, two had acromio-clavicular injury (type V), and one had distal clavicle fracture.

Clinical assessment

X-rays in the anteroposterior plane, in internal rotation, abduction, in the axillary plane, and in the supraspinatous-tunnel view were taken to exclude other shoulder disorders. Ultrasound was also performed for all patients. The subjective symptoms and objective findings of all shoulders were graded according to the adjusted Constant score (the Constant score after excluding the 25 points for the assessment of muscle strength) [5]. The maximum score for pain is 15, with 15 points representing no pain and 0 points being severe, constant pain. The ability to carry out daily activities is assigned a maximum of 20 points. Flexion, abduction, external rotation and internal rotation are each given a maximum of 10 points (total maximum score for motion: 40 points). The maximum score was therefore 75 points.

Technique

All patients received general anaesthesia for the procedure, using an intravenous barbiturate given by anaesthetists. The technique used for manipulation was started by gradual flexion in the sagittal plane to the maximum possible extent while the scapula was fixed. Next, passive external rotation was performed in 0° of abduction, followed by external rotation in 90° of abduction. Lastly, internal rotation at 90° of abduction and cross-body adduction were performed. Care was taken not to fracture the humerus during manipulation. External rotation forces were applied very carefully by two thumbs. A full range of motion was always achieved. The shoulder joint was injected with 3 ml bupivacaine and 1 ml of steroid. To avoid intraoperative complications, 6 patients (6/57, 10.5%) with refractory frozen shoulders who regained less than 80% of the range of motion subsequently underwent arthroscopic release and were not included in our series.

Postoperative treatment

All patients received immediate continuous passive exercise in the ward soon after the procedure. After discharge, exercise training with a physiotherapist in our outpatient clinic was continued until the range of movement was satisfactory.

After the operation, each patient was followed at 3 weeks, 3 months, 6 months and 1 year, and then at a final review. Additional visits were arranged if indicated. Each patient had a special chart with detailed records of

their personal data, the mechanism and associated condition of the injury, classification of the type of frozen shoulder, course of management (including the time of treatment, operation course, presence of early and late complications and management of complications) and the course of functional recovery. Shoulder function was measured at each follow-up visit, and all the examinations and records were performed by senior staff. The early follow-up period was 3 weeks on average, while the late follow-up period was 82 months (range: 18–153 months).

Statistical analysis

The Kruskal-Wallis test was used to determine the score difference between the three groups. If a difference was noted, Bonferroni correction was applied for multiple comparisons. All analyses were performed with the use of Statistical Analysis System software (version 6.12; SAS, Cary, NC).

Results

The average age of the patients at the time of presentation was 53.9 years old (range: 38 to 79 years old). The group comprised 16 male and 33 female patients. The average duration from the onset of the disease to manipulation was 6.8 months, with a range from 3 to 18 months. The minimum follow-up period was 18 months. The right shoulder was involved in 35 cases and the left in 16. Four patients had both shoulders involved, but on different occasions.

Shoulder stiffness noted during anaesthesia and the typical rasping noise occurring during manipulation con-

firmed the clinical diagnosis of frozen shoulders. All patients had complete functional assessments. These results are summarised in Table 1. The adjusted Constant score before manipulation was on average 22.8 ± 4.9 (10–31) points. The average follow-up period was 82 months (range: 18–153 months). The adjusted Constant score from early follow-up was 52.6 ± 9.2 (31–67) points on average with 13 shoulders scoring less than 50 points; the adjusted Constant score from the late follow-up was on average 70.1 ± 6.2 (54–75) points, with 23 shoulders scoring a maximum score of 75. However, the results are influenced by the natural course of the disorder if the follow-up period is longer than 12 months. There were no complications after manipulation. Significant improvement was seen 3 weeks after manipulation, and we found a very good early response to manipulation with a rise in the adjusted Constant score from the preoperative median of 30.4% to a post-manipulation of 70.2%. In our study, the adjusted Constant score at the 12-month follow-up was on average 69.4 (50–75), which was close to the late follow-up of 70.1 (54–75).

There was no difference in the baseline preoperative scores between the groups except in activity (Table 1, Fig. 1b). For the post-operative group at the late follow-ups, the mean pain score was 11.1 ± 2.1 , which was significantly lower than the other two groups (Table 1). The mean ROM score was 20.9 ± 3.4 and 33.7 ± 3.6 at the early and late follow-ups, respectively, which was also significantly lower than the other two groups (Table 1). However, activity of daily living at the late follow-ups did not differ significantly between these three groups (Table 1). Finally, the total adjusted Constant score at the early and late follow-ups was significantly lower for the post-operative group (63.2 ± 6.7) when compared to the other two groups (Table 1). The

Table 1 Results of the adjusted Constant score before, 3 weeks after and 82 months after surgery in the three groups

Timing	Score (points)	Groups			P value
		Idiopathic	Post-trauma	Post-surgery	
Before	Pain	4.23 ± 3	4.17 ± 3.5	3.1 ± 3.2	0.5263
	Activity	7.2 ± 1.8	7.2 ± 2.1	4.5 ± 2.4	<0.01*
	ROM	12.2 ± 2.4	12.5 ± 2.4	12.8 ± 2.2	0.6634
	Total	23.6 ± 4.2	23.8 ± 5.1	20.3 ± 4.4	0.1355
Post-surgery	Pain	12.5 ± 2.9	12.9 ± 3.3	10 ± 3.5	0.0495
	Activity	14.2 ± 2	14.8 ± 1.3	11.1 ± 2.5	<0.01*
3 weeks	ROM	29.6 ± 3.3	28.3 ± 3	20.9 ± 3.4	<0.01*
	Total	56.3 ± 6.8	56.1 ± 5.2	42 ± 8.4	<0.01*
Post-surgery	Pain	14.4 ± 1.6	14.9 ± 1.4	11.1 ± 2.1	<0.01*
	Activity	18.9 ± 1.7	19.5 ± 1.2	18.3 ± 1.6	0.0964
82 months	ROM	38.9 ± 1.9	39.2 ± 1.3	33.7 ± 3.6	<0.01*
	Total	72.3 ± 4.4	73.3 ± 2.5	63.2 ± 6.7	<0.01*

* $P < 0.01$, significantly lower scores in the post-surgery group
The values are given as the mean and the standard deviation

Fig. 1 **a** Improvement in pain 3 weeks after surgery; **b** improvement in activity 3 weeks after surgery; **c** improvement in ROM 3 weeks after surgery

results of post-injury and idiopathic frozen shoulders were similar at early and late follow-ups (Table 1).

Four shoulders took 1 year or more before reaching a satisfactory outcome, i.e., a spontaneous recovery. These four patients did not show much improvement in the range of motion at the 3-week follow-up. Three of them were from the post-operative group and one from the idiopathic group. So far, we have still been unable to identify any features associated with a poor outcome. Hence, the reason behind this failure to recover is still unknown.

In this series, there were no iatrogenic, neurological injury, fracture and dislocation complications.

Discussion

Untreated frozen shoulders usually resolve in their natural course within 1 to 3 years. The condition of frozen shoulder can cause severe pain that may require medication for several months and sometimes even results in some

limitation of movement, implying that the disease itself does not always have a successful long-term outcome [2, 22]. However, many authors have reported that this period of disability can be minimised by manipulation under anaesthesia [6, 11, 13, 14, 17].

This study reports our experience with the short- and long-term effects of treating 51 cases of idiopathic, post-injury and post-operative frozen shoulders by manipulation under anaesthesia over a mean follow-up period of 82 months. There was no recurrence in our long-term follow-ups. Four out of 47 patients (8.5%) had both shoulders involved. Diabetic patients were excluded from our study due to the fact that diabetes alone is a predisposing factor for secondary frozen shoulders.

To avoid intraoperative complications, six cases (10.5%) with refractory frozen shoulders that underwent open or arthroscopic release were excluded in our series. We did not see any intraoperative or postoperative complications following manipulation. However, shoulder dislocation, rotator cuff tear or brachial plexus palsy after manipulation have been reported [3]. Despite the fact that the Constant scoring system was excellent in assessing shoulder function, some authors state that the assessment of muscle strength prior to manipulation is almost impossible because most patients cannot abduct their shoulders to 90 degrees, and therefore result in false scores would result [4, 17, 18]. This is part of the reason we adopted the adjusted Constant score instead to assess and evaluate our patients.

An excellent early response to manipulation was found in short-term follow-ups, with a rise in the adjusted Constant score from a preoperative median of 30.4 to 70.2% post-manipulation. This early improvement never occurs in untreated frozen shoulders. In the series of Othman, the adjusted Constant score at the early follow-up was on average 54.9 points (28–75) [17], which was close to our average of 52.6 points (31–67). As for our long-term follow-ups, the scores were even better than those at the early follow-ups, therefore representing spontaneous recovery (Table 1).

Some authors state that manipulation alone should be sufficient for the majority of patients [15–17], with the arthroscope reserved for combined rotator cuff tear, sub-acromial decompression and refractory shoulder stiffness [12, 18, 19]. Due to the restricted volume of the glenohumeral joint, an arthroscope often damages the articular surface when entering the joint space. In our series, six cases of refractory frozen shoulders (10.5%) were converted to arthroscopic release (four in the idiopathic groups, one in post-injury and one in post-operative). Manipulation alone was sufficient for 89.4% of frozen shoulders in our series.

Some authors state that manipulation for patients with secondary frozen shoulders should be avoided due to its poor results [11, 13]. On the contrary, our patients with post-injury and post-operative frozen shoulders gained much improve-

ment. Similar improvement was also noted in the pain and activity of daily living among the three groups at early follow-up (Fig. 1a,b). However, significantly lower total scores were found at both early and late follow-ups in the post-operative group. The activity of daily living and ROM (Table 1) at early follow-ups mainly accounted for the low scores, while pain and ROM (Table 1) contributed to the low scores at late follow-ups. In the series of Holloway et al. [12], less improvement was also found in postoperative frozen shoulders after arthroscopic release. This was thought to be due to the initial trauma and operation. Therefore, outcomes in postoperative frozen shoulders, either with manipulation or arthroscopic release, were not as good as those from the idiopathic group. Interestingly, the activity of daily living at the late follow-ups did not differ significantly among these three groups (Table 1). On the contrary, the results of post-injury and idiopathic frozen shoulders were similar at early and late follow-ups due to lower energy trauma and nonoperative treatment.

We conclude that manipulation under anaesthesia after failure of initial conservative management speeds the recovery of idiopathic, post-injury and post-operative frozen shoulders and quickly improves shoulder function and symptoms. In treating post-operative frozen shoulders with manipulation, the results of the activity of daily living were shown to be as good as those for idiopathic frozen shoulder. Although less improvement in pain and ROM was noted, manipulation is still a good and simple way to treat post-operative frozen shoulders.

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