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Research Article

Arthroscopic Release Versus Manipulation Under Anesthesia for Frozen Shoulder - A Prospective Study

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Abstract

Introduction: Frozen shoulder is a painful condition of the joint for which surgery may be helpful when conservative treatment fails. In this prospective study, we compared two common methods of surgical treatment.

Patients and methods: Between April 2010 and March 2012, 54 patients with frozen shoulder were treated under anesthesia by one of the two methods of arthroscopic release and manipulation. The variables studied in the comparison were postoperative pain, ASES and SST scores, range of motion in different directions, and pain at the last post-surgery follow-up visit.

Results: All of the patients in the two groups had significant improvements in comparison to preoperative scores at a follow-up visit at least one year after surgery. The difference between the two groups was not significant in internal rotation, forward flexion, and pain at the final follow-up visit, but for the other variables, the arthroscopy group showed greater improvement. No statistically significant association was found among any of the variables considered in the comparison and diabetes, age, sex, and dominant limb involvement.

Conclusions: Based upon the findings of the present study it seems that both manipulation under anesthesia and arthroscopic release are effective treatments for frozen shoulder. However, arthroscopy was associated with less postoperative pain and greater improvement some parameters of range of shoulder motion, in comparison with manipulation under anesthesia. The results in diabetic patients were similar to those for nondiabetics in most respects.

Keywords: Anesthesia - Arthroscopy – diabetes - frozen shoulder –Manipulation.

Introduction

Frozen shoulder or adhesive capsulitis is a common cause of shoulder pain, characterized by pain and progressive limitation of passive and active shoulder motions [1]. It affects eight percent of men and ten percent of women of working age [2] and is two to four times more common in diabetics [3,4]. It is a self-limiting condition in most cases, and resolves spontaneously within 2 years [5], though in some cases the patient suffers pain and movement limitations lasting several years [6,7]. A high percentage of patients respond to conservative treatments, including analgesics, physiotherapy, and corticosteroids, and hyaluronate injections [8-10]. Surgical intervention is indicated in cases in which the patient doesn't get better with conservative therapy [5]. This may consist of open or, more recently, of arthroscopic, surgical release of adhesions or manipulation under anesthesia. Both of these methods have been associated with good outcomes and have proponents [11,12]. To the best of our knowledge, no clinical study comparing these two methods has been performed and the only study on the topic has been a systematic prospective case review, which emphasizes the need for a clinical study with patients randomized to one of the two study arms, arthroscopic release or manipulation under anaesthesia.

Materials and Methods

This prospective study was performed on patients referred to Kerman Medical Science University clinics between April 2010 and March 2012. Ethics Committee agreement was taken before the study began and the study was not financially supported (no funds received by any of the authors form any sources).

The inclusion criteria were

- Fe/male, 18 years old or older, who had provided written consent to participate in this study.
- Frozen shoulder syndrome diagnosis based on limitation of

active and passive shoulder movements (forward flexion <90, external rotation <50% of the opposite side, and internal rotation at the level of sacral vertebrae and L5).

- Unilateral involvement.
- Unresponsive to conservative therapy such as physiotherapy, injections and NSAIDS.
- Symptomatic period before surgery of at least 6 weeks.

Exclusion criteria were

- Any previous shoulder surgery.
- Any disease or situation that involved the shoulder such as recurrent dislocation, old fracture, or CNS disease.
- Systemic rheumatoid diseases such as Rheumatoid Arthritis.
- Pregnancy.
- History of injection in the shoulder (less than one month before surgery)

After receiving a comprehensive explanation about the two methods of treatment, patients included in the study were divided into two cohorts based on their individual preference: arthroscopic surgery and manipulation under anesthesia. In both groups, after a complete physical examination, standard forms (ASES and the Simple Shoulder Test) were filled out and the information provided was recorded.

For the examination of shoulder movements, the patient sat on the chair and four movements were recorded:

- Abduction: lateral movement of upper extremities in supination.
- Forward flexion: the ability of the upper extremity to move.
- External rotation: the amount of shoulder rotation when elbows were near the trunk.
- Internal rotation: the number of spinous process of vertebra that patient could reach her/his thumb to it.

A new variable for the comparison was defined as the total active movements of the shoulder, which was the sum of the mathematical values for external rotation, abduction, and forward flexion.

Surgery was performed under general anesthesia and in beach chair position. Via the posterior portal, diagnostic arthroscopy of the shoulder was performed and then an anterior portal was installed in the anterior soft spot with the use of a coablation wand (ArthroCare Corporation USA), capsular and ligament release was performed.

After complete release, the range of motion of the shoulder was examined for fullness and completeness, and if the range of motion did not meet this standard, another arthroscopic examination was performed. In the manipulation group, the standard technique (FEAR order) was used. With the patient on the operating table, in supine position after anesthesia and complete muscle relaxation, first flexion and then extension, abduction, and finally external and internal rotation were induced. After surgery, radiography was performed to assess possible dislocation. The amount of pain before surgery and in the first night after surgery was measured and recorded by an out-of-study observer. The patient was asked to show his/her pain on a scale with gradations from 1 to 10, the larger number showing more pain, 0 showing no pain, and 10 showing pain intense enough to make the patient think about suicide.

In the visits that followed surgery, patients were examined at regular intervals and physiotherapy was begun for as soon as possible. In the final follow-up at 12 months or more, patients were examined and ASES and the Simple Shoulder Test (SST) forms were filled out for them.

The simple shoulder test (SST) includes 12 questions evaluating 12 functions of the shoulder. The maximum score is 12 and the minimum is 0, so the higher the score, the better the function.

In 1993 the ASES questionnaire was designed and developed by a society of orthopedic surgeons, the American Shoulder and Elbow Surgeons, to produce a more accurate and standardized evaluation of shoulder and elbow function. This questionnaire is completed by the physician. In the first part, the patient answers questions about her/his own daily life, while in the second part, the pain score is evaluated, and finally the shoulder score index is calculated. The scale is 0 to 100; the higher the number, the less disability is to be expected.

Finally, the results were compared using SPSS 20 and statistical tests: the independent t-test, the paired samples t-test, linear regressions, the Wilcoxon signed-rank test, and Chi-square and ANCOVA analysis. Multiple statistical tests were utilized to increase the accuracy of findings and lessen the chance of error.

Results

Of the total number of referrals to our clinic, 76 patients were eligible for inclusion, of whom 60 gave informed consent for participation. At the end of the study, 25 patients in the manipulation cohort and 27 in the arthroscopy cohort had been followed for at

least 1 year (12 to 30 months). These included a total of 52 patients, 43 females and 9 males, with a mean age of 56.84 ± 8.04 (43 to 72 years of age). Eighteen patients were diabetic, ten in the arthroscopy group and eight in the manipulation group. Forty-eight of the patients were right-handed and in eight the dominant hand was the left. The "frozen shoulder" was on the dominant side in 28 patients (53.8%) and on the nondominant in 24 (46.2%).

Arthroscopic findings were: 7 cases with a complete rotator cuff tear, 10 patients with a partial tear, 16 patients with biceps tendonitis, and 16 patients with cartilage destruction.

The mean scores before and after surgery and the result of the examinations in the arthroscopic and manipulation groups have been shown in table 1.

Number	Manipulation		*P*-value Before and after in manipulation group	Arthroscopy		*P*-value Before and after in arthroscopy group	*P*-value Between the groups
	Before surgery	After surgery		Before surgery	After surgery		
	25			27			
Postoperative pain		6.70 ± 1.53			1.09 ± 3.96		<0.001
SST	8.66 ± 1.41	10.20 ± 0.76	<0.001	8.60 ± 1.35	10.77 ± 0.64	<0.001	0.001
ASES	0.36 ± 9.30	75.06 ± 6.26	<0.001	33.92 ± 9.05	80.68 ± 4.04	<0.001	0.001
Abduction	59.25 ± 9.57	150.40 ± 8.88	<0.001	58.40 ± 8.98	161.11 ± 7.51	<0.001	<0.001
ER	10 ± 5.54	24/6 ± 40/38	<0.001	10.40 ± 6.75	48.51 ± 7.81	<0.001	<0.001
FF	55.55 ± 7.51	151.20 ± 7.8	<0.001	54.40 ± 8.20	154.81 ± 7	<0.001	0.075
IR	93.3 sacrum, 3.7% L5	44.4% L5, 8%T10, 22.2%T7, 3.7%L3	0.006	92% sacrum, 8% L5	L560%, T1024%, T74%	0.001	0.584
Total motion	123.20 ± 18.19	340 ± 15.81	<0.001	124.81 ± 16.72	364.44 ± 16.48	<0.001	<0.001
Final pain score	7.36 ± 1.07	2.28 ± 0.84	<0.001	7.33 ± 1.17	1.92 ± 0.78	<0.001	0.122

Table 1: Scores, before and after the operation in the two groups.

For diabetic patients from both cohorts, the comparison between pre- and postoperative scores and results are shown in table 2. As shown in the table, the difference between the two treatment groups was statistically significant with respect to final ASES score, external rotation, total shoulder range of motion, and postoperative pain. In patients who underwent manipulation, there was no statistically significant difference among scores between diabetic and nondiabetic patients, except for the final pain score, which was higher in diabetics. In the arthroscopy patient cohort, no statistically significant difference existed between diabetics and nondiabetics, except for the final abduction value, which was higher in nondiabetics (Tables 3 and 4). The correlation between variables and the results were assessed by a linear regression model. No correlation was found among age, sex, diabetes, initial SST score and ASES score, the length of the symptomatic period before surgery, preoperative pain score, and dominant site involved and the final results, but a statistically significant correlation was found between individual shoulder range of motion parameters and the final measurements (Tables 5 and 6).

Discussion

The best treatment for frozen shoulder is still not definitively known. In this study we compared two common methods for treatment of this common disorder; according to our results,] arthroscopic release led to better results in terms of some parameters, but the difference was not great in others.

At the one-year follow-up of our patients, all of the scores showed obvious improvements, probably reflecting the benefits of surgery, but for us to be able to definitively conclude that these improvements resulted from surgery, these patients should be compared to patients who did not receive any treatment, as it may be possible, on the one hand, that the patients regained their normal range of shoulder motion and healed to the point where they were not experiencing pain after their shoulders "thawed" with the passage of time [5,14]. On the other hand, the fact that many variables' scores were better in the arthroscopy group at the one-year follow-up minimizes the probability that this is the case. At any rate, proving or disproving this hypothesis will require a study with a con-

Number	Manipulation		*P*-value Before and after in manipulation group	Arthroscopy		*P*-value Before and after in arthroscopy group	*P*-value Between the groups
	Before surgery	After surgery		Before surgery	After surgery		
	25			27			
Postoperative pain		4.25 ± 0.88	<0.001		6.70 ± 1.76		0.003
SST	8.37 ± 1.40	10.25 ± 0.88	<0.001	7.80 ± 1.47	10.60 ± 0.51	<0.001	0.120
ASES	30.61 ± 8.84	74.37 ± 0.11	<0.001	28.66 ± 0.86	81.85 ± 3.67	<0.001	0.003
Abduction	57.50 ± 1.64	151.25 ± 11.25	<0.001	56.00 ± 6.99	157.00 ± 6.74	<0.001	0.146
ER	7.50 ± 4.62	35.00 ± 5.34	<0.001	11.00 ± 5.67	49 ± 5.67	<0.001	<0.001
FF	50.00 ± 7.55	148.75 ± 8.34	<0.001	56.00 ± 43.8	154.00 ± 6.99	<0.001	0.549
IR	7 sacrum, 1 L5	2T7, 3 T10, 3 L5	0.001	10 sacrum level	4 T7, 3 T10, 3 L5	0.006	0.799
Total motion	115 ± 18.51	335.00 ± 19.27	<0.001	123.00 ± 14.18	360.00 ± 14.14	<0.001	0.004
Final pain score		2.87 ± 0.64	<0.001		2.30 ± 0.82	<0.001	0.125

Table 2: Scores, before and after the operation in the diabetic patients of two groups.

Number	Nondiabetic	Diabetics	*P*-Value
	17	8	
SST	10.17 ± 0.72	10.25 ± 0.88	0.828
ASES	75.38 ± 6.86	74.37 ± 5.11	0.715
Postoperative pain	3.82 ± 1.18	4.25 ± 8.88	0.376
Abduction	150 ± 7.90	151.25 ± 11.25	0.75
ER	40 ± 6.12	35 ± 5.34	0.06
FF	152.35 ± 7.52	148.75 ± 8.34	0.291
IR	11.8%T7, 17.6%T10, 70.6%L5	25%T7, 37.5%T10, 37.5%L5	0.289
Total shoulder motion	342.35 ± 13.93	335 ± 19.27	0.288
Final pain score	2 ± 0.79	2.87 ± 0.64	0.012

Table 3: Scores, before and after the operation in the diabetic patients of the manipulation group.

Number	Nondiabetic	Diabetics	*P*-Value
	17	10	
SST	10.88 ± 0.69	10.60 ± 0.51	0.277
ASES	79.99 ± 4.20	81.85 ± 3.67	0.257
Postoperative pain	6.70 ± 1.44	6.70 ± 1.76	0.993
Abduction	163.52 ± 7.01	157 ± 6.74	0.026
ER	48.23 ± 8.82	49 ± 5.67	0.809
FF	155.29 ± 7.17	154 ± 6.99	0.652
IR	5.9%L3, 11.8%T7, 29.4%T10, 52.9%L5	40%T7, 30%T10, 30%L5	0.309
Total shoulder motion	367.05 ± 17.59	360 ± 14.14	0.291
Final pain score	1.70 ± 0.68	2.30 ± 0.82	0.054

Table 4: Scores, before and after the operation in the diabetic patients of the arthroscopy group.

	Abduction	ER	FF	IR	Total ROM	Final pain score
Group	<0.001	<0.001	0.078	0.674	0.215	<0.001
Age	0.808	0.600	0.121	0.975	0.698	0.618
Sex	0.814	0.208	0.291	0.745	0.872	0.148
Diabetes	0.929	0.584	0.634	0.245	0.577	0.013
Time to operation	0.469	0.467	0.814	0.064	0.323	0.723
SST	0.727	0.275	0.928	0.785	0.424	0.920
ASES	0.855	0.196	0.642	0.639	0.324	0.352
Dominant involvement	0.408	0.584	0.143	0.235	0.655	0.476
Preoperative pain	0.619	0.089	0.993	0.729	0.253	0.140

Table 5: Correlation between preoperative variables and final results (the highlighted cells represent significant statistical finding).

Preop Final	SST	ASES	Abduction	ER	FF	IR	Total ROM
SST	<0.001						
ASES		<0.001					
Abduction			0.005				
ER				0.009			
FF					<0.001		
IR						<0.001	
Total ROM							<0.001

Table 6: Correlation between preoperative scores vs range of motion and final scores.

trol group who have not received any treatment, which itself has its problems, especially the fact that in a prospective study, depriving a patient of treatment who is suffering severe pain is not ethical.

The arthroscopy procedure may offer other important findings which were mentioned for our patients. Some conditions may be correctable at the time of surgery such as synovectomy for congestive synovitis; some other procedures may also be performed, such as a biceps tenotomy, which had also been performed in some of these patients previously [15]. In the same way, subacromial decompression may be performed in these patients arthroscopically; these concomitant procedures may help the patient achieve a more rapid and complete improvement.

None of the methods studied for treatment of frozen shoulder are without complications. Fortunately, in our series of frozen shoulder patients we did not encounter any complications, and a low rate of complications (rare) has been the experience of others, too. In fact, the rate of complications is about 0.5% [13], but they may be serious when they occur, and a review of the literature reveals a wide variety of them. Shoulder fracture dislocation [16], neuroparalysis [17], and rotator cuff tears [18] may occur with shoulder manipulation. During arthroscopic release, one must be careful of the axillary nerve in the vicinity of the anterior capsule, and shoulder instability and dislocation have been reported [19].

Diabetic patients are an important subgroup of frozen shoulder sufferers. Though the classification of frozen shoulder into a primary or secondary condition does not separate these patients from others [20], it has been mentioned that the disease is more common in diabetics [3,4,20,21]. Does treatment of this subgroup of patients lead to clinically different results? The lack of a significant difference or of a correlation between the comorbidities of diabetes and most of the final result scores in the present study suggests that it does not, or at least that there is not much difference between diabetics and nondiabetics, but it seems that this has not been a topic that has been studied extensively. A relatively exhaustive literature search did not turn up many articles on the topic. A relatively recent paper compared arthroscopic treatment of frozen shoulder in diabetics and nondiabetics [23] and concluded that results of treatment were not as good in diabetics, though they were similar in many respects. It is interesting that the findings of our present study concurred that abduction showed less improvement in diabetics than in nondiabetics. However, we found only one other study in which the results of manipulation under anesthesia were compared in diabetics and nondiabetics [24] and the authors,

similarly, did not find much difference between the two groups. But it must be considered that different studies involve different scoring scales, aside from range of motion, so this must be taken into account when comparing studies.

Some examples of different studies that have employed differing scoring scales are the following: Baums., *et al*. utilized SF36, SST, and ASES [25]; Chen., *et al*. used Constant [26]; Cinar., *et al*. Constant and UCLA [23], and Wang., *et al*. employed the Adjusted Constant scale [24]. We used SST and ASES, as, in our opinion, these scoring scales provided a more functional assessment of the shoulder and, again, in our experience and opinion were easier and more easily understood by the patient by the patient, though a glance at tables 5 and 6 reveals that neither scale was a good predictor of shoulder function. We propose that future studies employ standardized scales and scoring, so that drawing conclusions from the comparisons becomes easier.

Postoperative pain was significantly less among arthroscopy patients than for those who underwent manipulation. This may be an important category of superiority for arthroscopy, though there was no significant difference between the pain scores at the final follow-up assessment Since in manipulation under anesthesia no incision is made, less pain may be ascribed to surgically controlled incisions versus avulsion and tearing of tissues. In fact, it has been shown that pain after arthroscopic shoulder surgery is not different from pain after open surgery.

Since the correlation between each variable before and after operation was statistically significant, it may be concluded that intervention was of most benefit to patients who were less afflicted, ie, whose injury was less severe. Though this seems logical, we cannot justify this conclusion scientifically. However, the correlations among the variables within the arthroscopy cohort probably means that arthroscopy was of greater value in improving all of the movements studied except internal rotation and forward flexion. Again, the lack of correlation among the studied variables and other factors such as age, sex, diabetes, and dominant side involvement is an interesting finding, suitable for further study.

The most important limitation of the present study is the relatively small sample size, especially for diabetics, though the fact that the results demonstated statistical significance across many variables lessens the possibility that this was a fluke, but does not eliminate it; nevertheless, a larger sized sample would be more definitive. The second limitation was lack of randomization, which we did not perform because of specific conditions limiting the study's design parameters.

Based upon the findings of the present study it seems that both manipulation under anesthesia and arthroscopic release are suitable treatments for frozen shoulder. Also based on our finding, it seems that arthroscopy will be associated with less postoperative pain, and shoulder motions in forward flexion and external rotation would be more improved through treatment with arthroscopic release. Finally, it seems that in most respects, treatment results will be similar in diabetics and nondiabetics.

Conflict of Interest

The authors declare that they have no conflict of interest.

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