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CLINICAL RESEARCH

Motion and Pain Relief Remain 23 Years After Manipulation Under Anesthesia for Frozen Shoulder

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Abstract

Background Manipulation under anesthesia (MUA) as treatment for idiopathic frozen shoulder increases motion, provides pain relief, and restores function, but it is unclear whether the improvements persist long term.

Questions/Purposes We therefore investigated whether (1) ROM was restored, (2) pain was relieved, and (3) function was restored and maintained after several decades in patients with idiopathic frozen shoulder treated by MUA.

Methods We followed 15 patients (16 shoulders; 12 in women) at 3 months, 7 years, and 19 to 30 years after MUA for frozen shoulder. Their mean age at MUA was 48.5 years. Four patients had diabetes. The time between the onset of symptoms and manipulation averaged 7.6 months. We determined pain by a patient-generated VAS (range, 0–10; 0 = none, 10 = maximal). We recorded ROM and Constant-Murley scores at last followup.

Results At 7 years, improvement had occurred in forward flexion to 155°, abduction to 175°, external rotation to 51°, and internal rotation to the T7 level. During the next 16 years, ROM deteriorated by 8° to 23° at last followup, but still equaled ROM of the contralateral shoulder. On the VAS, pain at last followup averaged 1.5 with exertion, 0.3 at rest, and 0.8 at night. The Constant-Murley score was 70 (range, 34–88); 12 patients reached the age- and sex-adjusted normal Constant-Murley score.

Conclusions In this group of patients treatment of idiopathic frozen shoulder by MUA led to improvement in shoulder motion and function at a mean 23 years after the procedure.

Level of Evidence Level IV, therapeutic study. See Instructions for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution approved the human protocol for his investigation, that all investigations were concluded in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.
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Introduction

Spontaneous adhesive capsulitis of the shoulder, idiopathic frozen shoulder, is a common, self-limiting disease [7]. Its etiology is uncertain, but its natural course is well known. Approximately 90% of patients with spontaneous frozen shoulder recover naturally to the normal level [21, 25], and there is little long-term advantage in any of the treatment regimens [1]. In patients without any particular treatment, the duration of the disease averages approximately 15 months [25].

For patients with persistent symptoms, manipulation under anesthesia (MUA) is one option. Several retrospective studies suggest that duration of symptoms may be

reduced by MUA [3, 8, 9, 14–18, 20, 22, 24, 27, 28], but others state that MUA has no advantages over nonoperative treatment [8, 11, 19]. In addition, MUA reportedly risks humeral fracture, rotator cuff tear, shoulder dislocation, labral lesions, or nerve palsy [12, 13, 18]. In 1992, the senior author (MV) evaluated 26 patients followed for a mean of 7 years (range, 3–14 years) after MUA [26]. In that study, he found 157° flexion, 176° abduction, 48° external rotation (improvements by respective 59°, 100°, and 35°), and satisfactory pain relief. However, it was uncertain whether this improvement would persist.

To determine whether the findings would persist, we assessed these patients to determine whether (1) ROM was restored, (2) pain was relieved, and (3) function was restored and maintained with time.

Patients and Methods

Indications for MUA were severe pain or inability to work beyond 6 months after onset of symptoms. Of the original 26 patients treated from 1977 to 1989, four had died. Of the remaining 22 patients, 15 (16 shoulders; 12 women) agreed to participate in the last followup evaluation at 19 to 30 years (mean, 23.1 years) after MUA. Their mean age was 48.5 years at MUA and 72 years during this study. The two main reasons for refusal to participate were poor physical condition for one, and lengthy travel for followup for six. We obtained permission to perform this study from the ethics committee of the hospital district where the study was conducted.

The criteria for inclusion in 1992 were (1) no or only minor shoulder trauma, (2) marked loss of active and passive shoulder motion (forward flexion $< 120°$ and/or abduction $< 120°$, external and internal rotation almost absent), (3) normal findings on a true AP radiograph of the glenohumeral joint, and (4) MUA. Patients with diabetes mellitus and thyroid dysfunction were included. Exclusion criteria included (1) intrinsic glenohumeral disorder such as glenohumeral arthritis or rotator cuff tear, (2) any history of substantial shoulder trauma, and (3) previous or subsequent shoulder surgery. At the 1992 followup, the patients' ROM in the contralateral shoulder was normal (mean flexion 157°, abduction 177°, external rotation 56°, and internal rotation to T11), however, seven patients had experienced pain in that shoulder, and one shoulder had undergone MUA. The delay between onset of symptoms and MUA averaged 7.6 months (range, 4.5–12 months). The dominant shoulder was involved in seven of the patients. Four patients had diabetes and three had thyroid disease, but none had Dupuytren's contracture. None of the patients had experienced any shoulder trauma before onset of the original symptoms. The mean preoperative flexion was 100°, abduction 78°, external rotation 11°, and in internal rotation the dorsum of the hand could reach the buttock level. One patient fulfilled our inclusion criteria for both of her shoulders. No subjective or objective assessment methods had been used at the time of MUA 19 to 30 years earlier. Since the 1992 study, seven patients have had contralateral frozen shoulder observed during followup. Four of these shoulders had been treated with MUA.

A moderate amount of short-acting barbiturate anesthetic causing sufficient muscle relaxation was administered by manual mask ventilation with the patient supine, without any special muscle relaxant. The technique used for MUA consisted of gradual alternate abduction and forward elevation followed by external and internal rotation, with care taken not to fracture the humerus (the senior author [MV] has seen two sequelae of humeral fractures during MUA). The goal was free or almost-free ROM with the characteristic feeling of tearing. One patient's frozen shoulder was manipulated twice at an interval of 10 months.

All patients were offered a standard postoperative physiotherapy program of passive and active rehabilitation. Passive exercises were performed in the recovery room. The program consisted of pool exercises within 24 hours of the procedure and progressed to land-based exercises. Typically, each supervised session lasted for 30 to 45 minutes, and each patient received two to three hydrotherapy and three to four land-based physiotherapy sessions before discharge. Afterward, ambulatory physiotherapy continued twice a week for 1 to 3 months.

The patients underwent a physical examination on six occasions: 1 month preoperatively, just before MUA, and a mean 6 days, 3 months, 7 years, and 23 years postoperatively. At last followup we reviewed all medical histories. An independent observer (HV) performed a physical examination on all patients. Presence of a painful arc sign was indicated by yes or no. We assessed shoulder function using the Constant-Murley score [2]. Because a normal shoulder's strength may differ by gender and deteriorate with age, we also calculated the normalized age- and sex-related Constant-Murley score using the formula suggested by Katolik et al. [10]. Active and passive shoulder motion were measured with a hand-held goniometer assessing bilateral active motion simultaneously with the patient in a standing position. Active forward flexion and abduction were evaluated by measuring the angle formed by the arm and thorax. Active external rotation was evaluated with the arm adducted and the elbow flexed to 90°. Active internal rotation of the arm behind the back was assessed by the method we have used for decades, by determining the vertebral level that can be reached by the dorsum of the hand. Passive shoulder motion was evaluated the same way. Shoulder strength was evaluated with manual muscle testing, except strength in abduction for the Constant-Murley score was evaluated by

Table 1. Short-, long- and very long-term shoulder ROM in patients who underwent MUA for frozen shoulder

Time	Flexion (°)	Abduction (°)	External rotation (°)	Internal rotation (vertebral level reached by the dorsum of the hand)
1 month before MUA	99 (70–120)	75 (15–125)	21 (0–90)	Buttock (buttock)
Just before MUA	100 (90–120)	78 (50–120)	11 (0–45)	Buttock (buttock)
6 days after MUA	145 (120–170)	132 (30–180)	33 (20–60)	L5 (S1–L3)
3 months after MUA	150 (115–180)	137 (80–180)	31 (15–40)	L5 (buttock to T12)
7 years after MUA	155 (130–170)	175 (135–180)	51 (25–80)	T12 (S1–T7)
23 years after MUA	145 (100–170)	152 (75–185)	43 (20–70)	L1 (buttock to T7)

Values are expressed as mean, with range in parentheses; MUA = manipulation under anesthesia.

Table 2. ROM of affected (once frozen) and contralateral shoulders at 23 years after MUA

ROM parameter	Affected shoulder	Contralateral shoulder	p value
Flexion (°)	145 (100–170)	147 (100–175)	0.440
Abduction (°)	152 (75–185)	152 (75–185)	0.882
External rotation (°)	43 (20–70)	47 (20–65)	0.115
Internal rotation (vertebral level reached by the dorsum of the hand)	L1 (buttock to T7)	L2 (buttock to T7)	0.135

Values are expressed as mean, with range in parentheses; MUA = manipulation under anesthesia.

using a Salter spring balance up to 11 kg at increments of 0.2 kg [25]. In addition, a true AP radiograph of both shoulders in external rotation was taken to assess possible degenerative changes of the joint.

Questionnaires [25] were mailed to the patients in September 2008, along with an invitation to participate in the study. The questionnaire concerned demographics and symptoms of the surgically treated shoulder including pain evaluation on a VAS (range, 0–10; 0 = no pain and 10 = maximal, intense pain). In addition, patients received the Simple Shoulder Test (SST) questionnaire [23]. They completed these questionnaires at home and returned them at the followup.

We determined differences between the shoulders in ROM, pain, and function using a t-test. As a nonparametric test we used the Mann Whitney U-test. We determined differences in categorical variables using Pearson's chi-square test. We performed all statistical analyses with SPSS® (Version 19.0; SPSS Inc, Chicago, IL, USA).

Results

Active ROM of the affected shoulders had improved to normal by 1992. Over the next 16 years, however, mean ROM deteriorated from 8° to 23° (Table 1). Final ROM of the affected shoulders reached the same level as ROM of the contralateral unaffected shoulders (Table 2). Patients with poor external rotation at MUA still had 10° inferior external rotation 3 months after MUA (23° versus 33°; $p = 0.248$) and at the 7-year followup (44° versus 54°; $p = 0.259$). However, at the last followup, mean external rotation was the same (43° versus 43°), with no difference between the Constant-Murley scores. At the last followup, patients with insufficient internal rotation at MUA reached a vertebral level of L4 versus T12 in the other patients ($p = 0.095$), with the Constant-Murley score averaging 57 versus 75 ($p = 0.202$). Clinical examinations showed glenohumeral motion was free in seven patients, somewhat restricted in seven, and severely restricted in one patient with bilateral arthritis. Diabetes had no affect on outcome in this series (flexion 145° versus 145°, abduction 139° versus 156°, and external rotation 40° versus 44° in patients with diabetes versus patients without diabetes). Compared with patients with flexion greater than 150° 3 months after MUA, patients with flexion less than 150° had inferior (all $p < 0.033$) ROM at final followup: mean flexion 155° versus 127°, abduction 170° versus 120°, external rotation 56° versus 30°, and internal rotation T11 versus L4).

At 7 years of followup, 12 patients had no pain at all at night, two had slight pain, and one occasionally had moderate night pain. At the last followup, VAS pain scores averaged 0.3 at rest, 1.5 with exertion, and 0.8 at night. Seven patients had totally painless shoulders (VAS = 0 with exertion, at rest, and at night). Six patients reported some kind of pain in the manipulated shoulder during the final year. Shoulder pain to some degree affected everyday tasks or hobbies for two patients. Only one patient had a VAS pain score greater than 3 with exertion, at rest, and at night. This patient was an 81-year-old woman with a history of bilateral frozen shoulders; she had reported occasional moderate night pain in 1992 and by 2008, she had severe bilateral shoulder arthrosis. Her Constant-Murley score was 34. In 1992, her ROM and shoulder radiographs had been normal. She was the only patient with

bilateral frozen shoulders in this study, ie, MUA of the contralateral shoulder had been performed in our hospital and we had adequate preoperative files. The final ROM of these shoulders was similar to that of the unaffected contralateral shoulders. Patients with diabetes reported VAS pain scores of 2.2 versus 1.3 at rest, 0.5 versus 0.3 with exertion, and 0.7 versus 0.8 at night, compared with patients without diabetes (all $p > 0.458$).

The Constant-Murley score averaged 70 (range, 34–88 and the normalized Constant-Murley score averaged 83 (range, 42–100); 12 patients reached the age- and sex-related normal Constant-Murley score and three (four shoulders, one bilateral) did not. Of the three patients, one had severe arthritis (bilateral shoulders), one had diabetes, and one had severe pulmonary fibrosis. The latter two patients had almost normal shoulder radiographs. Age, diabetes, smoking, alcohol use, length of symptoms before MUA, ROM before MUA, thyroid disease, or gender showed no correlation with function. For the SST, the mean number of yes responses was 10 (range, 7–12). In 1992, one patient with insulin-dependent diabetes was not satisfied with his ROM, but at last followup, he reached the normal age- and sex-related Constant-Murley score. Of the 15 patients, 13 were retired, two because of the shoulder disorder. Both of these latter two patients, one woman with pulmonary fibrosis (who had MUA twice) and one with arthritis, were satisfied with their pain relief and ROM in 1992: flexion 155° and 170°, abduction 170° and 180°, external rotation 40° and 25°, internal rotation L2 and T11, respectively. At last followup, their Constant-Murley scores were 58 and 77.

However, patients with diabetes were younger ($p = 0.008$) at MUA: 41 years versus 51 years.

Two fracture complications occurred: a small fracture of the inferior glenoid rim, which had not been seen on radiographs before MUA, was detectable on 1992 radiographs in each of two patients with no history of other trauma. In 2008, ROM at discharge and at last followup, Constant-Murley score, SST, and radiographic findings of these two patients did not differ from the others. They had no arthritic changes.

Discussion

Several retrospective studies suggest that duration of symptoms of idiopathic frozen shoulder may be reduced by MUA [5, 9, 14, 16–18, 20, 24, 27, 28]. However, the very long-term clinical outcome after MUA is unknown, with only one questionnaire survey published [4]. In 1992, 26 patients followed a mean of 7 years after MUA for spontaneous frozen shoulder were evaluated and a substantial increase in ROM and appropriate pain relief were found [26]. To determine whether the findings would persist, these patients were reassessed a mean 23 years after MUA to determine whether (1) ROM was restored, (2) pain was relieved, and (3) function was restored and maintained with time.

We acknowledge limitations to our study. First, it is difficult to estimate the influence of MUA because the natural course of frozen shoulder is mostly in a positive direction. Our indications for manipulation therefore were strict, and only approximately 10% to 20% of our patients with frozen shoulder had manipulation. Second, seven of the contralateral shoulders also were frozen shoulders and four of them were manipulated after the 7-year followup. However, the ROM of these shoulders did not differ from ROM of other contralateral shoulders. Third, our patient population was small. We could contact only 15 of the original patients, four had died, and others were too old to attend the last followup. Fourth, active internal rotation of the arm behind the back was assessed by the method we have used for decades, by determining the vertebral level that could be reached by the dorsum of the hand. Others [6] have questioned the accuracy

Table 3. Published studies on manipulation under anesthesia for frozen shoulder*

Study	Preoperative flexion	Preoperative abduction	Preoperative external rotation	Preoperative internal rotation	Followup flexion	Followup abduction	Followup external rotation	Followup internal rotation
Reichmister & Friedman [22]	111	97	12	32	171	171	78	84
Flannery et al. [5]	69	54	29	37	159	155	76	73
Quraishi et al. [19]	95	80	26	47	132	136	49	60
Farrell et al. [4]	104		23	L 5	168		61	T 12
Thomas et al. [24]	65	62	17	17	169	168	65	65
Kivimäki et al. [11]	104	78	18	38 cm	144	150	48	22 cm
Massoud et al. [14]	80	68	4	Buttock	152	146	40	L 1–L 2
Current study	100	78	11	Buttock	145	152	43	L 1

* Preoperative and followup active ROM, mean degrees.

of this method and suggest their measuring tape method, by which distance is measured between the C7 spinous process and the hand position.

Table 4. Very long-term progressive development of (once frozen) shoulder ROM after MUA

Variable	Farrell et al. [4]	Current study
Number of shoulders	19	16
Mean followup (years)	15 (8–21)	23 (19–30)
Mean patient age at followup (years)	66	72
Flexion (°)		
Before MUA	104 (mean)	100 (mean)
After MUA	+ 47.5	+ 45
Last clinical control*	+ 2.5	+ 5
7 years after MUA		+ 5
Very long-term followup†	+ 14 168 (mean)	− 10 145 (mean)
External rotation (°)		
Before MUA	23 (mean)	11 (mean)
After MUA	+ 25	+ 22
Last clinical control*	+ 5	− 2
7 years after MUA		+ 20
Very long-term followup†	+ 8 61 (mean)	− 8 43 (mean)

* Farrell et al. [4] = approximately 6 months after MUA; current study = mean 3 months after MUA; †Farrell et al. [4] = questionnaire survey; current study = clinical examination; MUA = manipulation under anesthesia.

In one retrospective study of 32 patients, ROM improved to normal on average in 13 weeks after MUA, and lasted for at least 5 years [22]. The improvement in ROM lasted at least 3.5 years in one retrospective study of 246 patients [24] and 5 years in another study with 145 patients [5] (Table 3). According to a questionnaire survey a mean 15 years after MUA for 18 patients [4], forward flexion estimated by the patients reached 180° and external rotation reached 90° in almost all shoulders. The patients were an average of 66 years old at the time of that survey. A healthy population in our country almost never attains that ROM at that age. We suspect that patients overestimate ROM in questionnaires. The results of Farrell et al. [4] are similar to ours (Table 4). In our study, ROM had recovered to normal at the 7-year evaluation but had deteriorated by 6% to 16% during the next 16 years, however, reaching the contralateral level. That deterioration could be explained by patient aging [10].

Pain diminished from a mean VAS score of 7.6 to 1.5 in 31 patients at 14 months' followup after MUA [7] and from a median VAS score of 8 to 1 for 146 patients at a mean 5-year clinical followup [5]. In a 15-year long-term questionnaire review, of 18 patients, only two experienced transitional pain in the manipulated shoulder [4]. In our study, pain also was minimal after 23 years, except for two arthritic shoulders (Table 5).

Thomas et al. reported the Oxford Shoulder Score (OSS) improved from a mean of 27 to 44 after 3.5 years [24]. At 5 years, the OSS has improved from a median of 12 to 40 [5]. In the 15-year questionnaire survey, the SST averaged

Table 5. Published studies on manipulation under anesthesia for frozen shoulder

Study	Number of patients	Age (years)	Female (%)	Duration of symptoms (months)	Pain at followup	Function	Followup (years)
Reichmister & Friedman [22]	32	54	84	7	Relief in 97%		5
Flannery et al. [5]	145	60	67	6½	VAS 1		5
Quraishi et al. [19]	17	55	58	10	VAS 2.7	Constant-Murley score 60	0.5
Farrell et al. [4]	18	51	68		No or slight 16, moderate or severe 3	American Shoulder and Elbow Surgeons score 80	15
Jakobs et al. [8]	28	57	54	5			2
Thomas et al. [24]	230	57	59	7		Oxford Shoulder Score 44	3.5
Kivimäki et al. [11]	38	53	71	7		Shoulder Disability Questionnaire (0–28) 9.6	0.5
Massoud et al. [14]	43	48	37	14	Constant-Murley score 11	Constant-Murley score 64	3
Current study	15	48	80	8	Rest 0.3, exertion 1.5, night 0.8	Constant-Murley score 70	23

9.5 of 12 and the American Shoulder and Elbow Surgeons score 80 of 100 [4]. In our study, of 15 patients, 12 reached the age- and sex-adjusted normal Constant-Murley score, and the SST averaged 10 of 12 (Table 5).

Complications related to MUA are unusual, but they do exist [12, 13, 15, 18]. We found two glenoid rim fractures that did not affect the outcome. In the 1980s, the senior author (MV) saw two humeral fractures and two habitual dislocations, but none after that time. We believe these can be avoided.

Normal ROM in the elderly does not persist throughout life [10]. In the current study, ROM deteriorated between 7 and 23 years after manipulation. However, MUA leads to full improvement of ROM and leaves no pain in 90% of patients in the long term. For patients with excessively severe pain and stiffness who do not respond to nonoperative treatment in 6 months, we recommend MUA as one treatment option.

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