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End-Range Mobilization Techniques in Adhesive Capsulitis of the Shoulder Joint: A Multiple-Subject Case Report

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Background and Purpose. The purpose of this case report is to describe the use of end-range mobilization techniques in the management of patients with adhesive capsulitis. **Case Description.** Four men and 3 women (mean age = 50.2 years, SD = 6.0, range = 41–65) with adhesive capsulitis of the glenohumeral joint (mean disease duration58.4 months, SD = 3.3, range = 3–12) were treated with end-range mobilization techniques, twice a week for 3 months. Indexes of pain, joint mobility, and function were measured by the same observer before treatment, after 3 months of treatment, and at the time of a 9-month follow-up. In addition, arthrographic assessment of joint capacity (ie, the amount of fluid the joint can contain) and measurement of range of motion of glenohumeral abduction on a plain radiograph were conducted initially and after 3 months of treatment.
Outcomes. After 3 months of treatment, there were increases in active range of motion. Mean abduction increased from 91 degrees (SD = 16, range = 70–120) to 151 degrees (SD = 22, range = 110–170), mean flexion in the sagittal plane increased from 113 degrees (SD = 17, range = 90–145) to 147 degrees (SD = 18, range = 115–175), and mean lateral rotation increased from 13 degrees (SD = 13, range = 0–40) to 31 degrees (SD = 11, range = 15–50). There were also increases in passive range of motion: Mean abduction increased from 96 degrees (SD = 18, range = 70–125) to 159 degrees (SD = 24, range 110–180), mean flexion in the sagittal plane increased from 120 degrees (SD = 16, range = 95–145) to 154 degrees (SD = 19, range = 120–180), and mean lateral rotation increased from 21 degrees (SD = 11, range = 10–45) to 41 degrees (SD = 8, range = 35–55). The mean capacity of the glenohumeral joint capsule (its ability to contain fluid)

increased from 10 cc (SD = 3, range = 6–15) to 15 cc (SD = 3, range = 10–20). Four patients rated their improvement in shoulder function as excellent, 2 patients rated it as good, and 1 patient rated it as moderate. All patients maintained their gain in joint mobility at the 9-month follow-up.

Discussion. There seems to be a role for intensive mobilization techniques in the treatment of adhesive capsulitis. Controlled studies regarding the effectiveness of end-range mobilization techniques in the treatment of adhesive capsulitis are warranted. [Vermeulen HM, Obermann WR, Burger BJ, et al. End-range mobilization techniques in adhesive capsulitis of the shoulder joint: a multiple-subject case report.

SYMPTOMS OF ADHESIVE CAPSULITIS DEVELOP OVER 6 MONTHS, MAY LAST 2 YEARS, AND THEN GRADUALLY DISAPPEAR.

Adhesive capsulitis or frozen shoulder is characterized by an insidious and progressive loss of active and passive mobility in the glenohumeral joint presumably due to capsular contracture.[1,2] Despite research in the last century, the etiology and pathology of adhesive capsulitis remain enigmatic.[3]

Pain, particularly in the first phase of adhesive capsulitis of the shoulder,[1–3] often keeps patients from performing activities of daily living (ADL). In our experience, many patients complain about sleeping disorders due to pain and their inability to lie on the affected shoulder. In the second phase of the condition, pain appears to be less pronounced, but the restrictions in active motion appear to limit the patient in personal care, ADL, and occupational activities. Observation of active shoulder motion appears to reveal excessive scapular motion and lifting of the shoulder girdle. In the third phase of the condition, there is a slow increase in mobility, which leads to full or almost full recovery.[4–6] According to Reeves,[4] the first phase of adhesive capsulitis of the shoulder lasts 2½ to 9 months, the second phase lasts 4 to 12 months, and the third phase lasts 5 to 26 months. Several authors[4,7–14] have argued that adhesive capsulitis is a self-limiting disease with a duration varying from 1 to 3 years, but they offered little or no peer-reviewed data to support this argument.

The axillary recess, a pouch of the glenohumeral capsule evolving from the inferior rim of the glenoid cavity to the inferior part of the humeral head, in our opinion, plays an important role in adhesive capsulitis. We believe that capsular adhesions of the axillary recess hinder normal expansion during abduction resulting in diminished active and passive mobility of the shoulder. An important feature of adhesive capsulitis is the decreased joint capacity (ability of the capsule to move as indicated by an inability to hold fluid) due to capsular retraction, as determined by arthrography (the roentgenographic visualization of the joint to determine the amount of fluid the joint can contain).[2,15–17] In our clinic, shoulder arthrography is often used as a standard orthopedic procedure to refine the differential diagnosis of limited range of motion in several pathological conditions of the shoulder. Normally, 16 cm^3 of dye solution can be injected without resistance.[18] A decreased joint capacity (less than 15 cm^3) in combination with the characteristic restrictions of range of motion (ROM) of the shoulder in lateral rotation, flexion in the sagittal plane, and abduction confirms the diagnosis of adhesive capsulitis.

To regain the normal extensibility of the shoulder capsule, passive stretching of the shoulder capsule in all planes of motion by means of end-range mobilization techniques (EMTs) has been recommended,[19,20] but data to support the use of these treatments are lacking. These techniques have been described by Maitland,[20] Cyriax,[21] and Kaltenborn,[22] but they did not base their suggestions on research. Although these techniques are frequently used by physical therapists and manual therapists, few studies have described the use of these techniques in joints with capsular adhesions. In 3 studies,[23–25] the shoulder was examined. Other studies examined the wrist,[26] the temporomandibular joint,[27] the ankle,[28] and the metacarpophalangeal joint.[29] Although mobilization techniques were used in the 3 studies of the shoulder, the performance of the techniques (mid-range mobilizations combined with interscalene brachial plexus block), duration of treatment (4–6 weeks), and utilization of other treatment modalities (home exercises, cold packs) differs from the approach we used with patients. We used EMTs without the support of anesthetic techniques or additional modalities. In our opinion, based on histological studies of contracted joint capsules in animals,[30,31] a remobilization period should last

for at least 12 weeks to realize the remodeling of connective tissue and to normalize ROM. To exclude possible concurrent effects, we did not use physical modalities such as cold packs or heat. We examined the change in shoulder mobility and joint capacity after EMTs during a treatment period of 3 months.

CASE DESCRIPTION

All patients with frozen shoulders were referred for treatment by an orthopedic surgeon to the physical therapy department and fulfilled the following inclusion criteria: (1) having a painful stiff shoulder for at least 3 months, (2) having restriction of more than 50% in passive shoulder abduction, flexion in the sagittal plane, or lateral rotation compared with the opposite side, and (3) having a maximal glenohumeral joint capacity of 15 cm^3. In the absence of a generally accepted definition of frozen shoulder, a consensus group of orthopedic surgeons and physical therapists in our hospital agreed on this set of clinical criteria for a frozen shoulder. Excluded were patients with (1) diabetes mellitus, (2) a painful stiff shoulder after a severe trauma, or (3) the presence of osteoarthrosis or signs of bony damage due to trauma on the radiographs of the affected shoulder.

We applied interventions to 7 eligible patients (4 men and 3 women) with a mean age of 50.2 years (SD = 6.0, range = 41–65) and a mean disease duration of 8.4 months (SD = 3.3, range = 3–12). In all patients, the cause of the adhesive capsulitis (primary or idiopathic) was not known. In 3 patients, the dominant arm was involved. Six patients had received prior treatment by physical therapists in a private practice (mean number of intervention sessions = 12, median = 12, range = 6–34). These interventions consisted of massage of the shoulder region, physical modalities (ie, ultrasound, shortwave diathermy, and electrotherapy), gentle passive mobilization techniques, and active exercises. Three patients had received a corticosteroid injection in their affected shoulder from their general practitioner; 1 patient received 4 injections. None of the patients reported satisfactory results (progress in mobility, pain, or ADL) from the previous physical therapy or the treatment administered by their general practitioner (Tab. 1). Assessments took place prior to treatment (t_0), after 3 months of treatment (t_1), and 9 months after treatment (t_2). A detailed history of complaints and disabilities in daily life (eg, sleeping disorders; disabilities in personal care, reaching tasks, and professional activities) was taken for each patient at each assessment.

[TABLE 1]

We used active mobility and pain as primary outcome measures because we believe that they are important features in adhesive capsulitis. Patients were asked for the presence of pain during ADL and at night. We did not, however, assess the reliability of these measurements, and the reliability of these measurements for patients with adhesive capsulitis is not known. Our data, therefore, must be viewed with caution. We considered the treatment result for active mobility to be “excellent” if the deficit in mobility was 20 degrees or less in all 3 directions (abduction, flexion in the sagittal plane, and lateral rotation) as compared with the opposite glenohumeral joint. A “good” result was scored if the deficit in joint mobility was between 20 and 30 degrees in 1 or more directions. This idea is similar to the scoring system of Heller et al[32] for the evaluation of posteriorly dislocated shoulders. Maximum ROM, among other variables, is used to classify shoulder function.[32]

Active and passive flexion in the sagittal plane, abduction, and lateral rotation of both shoulders were measured with each patient in a standing position using a conventional goniometer at t_0, t_1, and t_2.[33] Measurements were rounded to the nearest 5 degrees according to the clinical procedures for recording joint motion used in our clinic. All assessments were performed by the same physical therapist (GJK). This therapist, who had 12 years of experience, was not involved in the treatment of the patients and was unaware of the previous measurements. The patients rated the overall progress of their shoulder function on a 5-point Likert scale (“much worsened” to “much improved”). Again, caution should be used in interpreting these data because the reliability and validity of these measurements have not been demonstrated.

Radiological assessments were performed at t_0 and t_1 by the same radiologist (WRO). Anteroposterior views of both shoulders were radiographed with the patients standing with the shoulder in maximal active abduction. A line was drawn on the radiograph between the inferior angle of the scapula and the

inferior glenoid cavity, and a second line was drawn over the midshaft of the humerus. Maximal abduction was determined by measuring the angle (in degrees) between the 2 lines with a goniometer according to the procedure described by Nelson et al[34] and Freedman and Munro.[35]

Arthrography of the affected shoulder was performed according to the technique described by Neviaser.[36] This outpatient procedure was done with the patients in a supine position under sterile circumstances. A skin marker was used to identify the joint space between the humeral head and the glenoid cavity, and its position was confirmed by fluoroscopy. A local anesthetic was infiltrated into the skin and the subcutanous soft tissues including the anterior shoulder capsule. A needle was then inserted into the glenohumeral joint, and a fluid containing a mixture of Hexabrix[*] and Xylocaine[†] 2% in a ratio of 1:1 was injected. The amount of fluid injected without overpressure (pressure to fill the joint capsule with dye solution after resistance is felt on the syringe) is considered to be the joint capacity. In addition, changes in the size of the axillary recesses were determined by comparing radiographs obtained before and after treatment. A joint capacity of 15 cm^3 or less, in combination with obliteration of the axillary pouch and the subscapular bursa on the arthrogram, is typical for adhesive capsulitis if the patient has restricted ROM for which no other cause can be identified.[4,36] Reliability has not been demonstrated for this capacity measure.

Intervention using EMTs started after the radiological assessment and was given twice a week for 30 minutes. We used the techniques described by Maitland,[20] as follows. At the start of each intervention session, the physical therapist examined the patient's ROM in all directions to obtain information about the end-range position and the end-feel of the glenohumeral joint. Intervention started with a few minutes of warm up consisting of rhythmic mid-range mobilizations with the patient in a supine position. Thereafter, the therapist's hands were placed close to the glenohumeral joint, and the humerus was brought into a position of maximal flexion in the sagittal plane. After 10 to 15 repetitions of intensive mobilization techniques in this end-range position, the direction of mobilization was altered by varying the plane of elevation or by varying the degree of rotation. In addition, as an alternative to varying the direction of mobilization, other movements such as gliding techniques and distraction in that joint position were used. In each direction of mobilization, 10 to 15 repetitions were performed, and the mobilization grade (3 or 4) and the duration of prolonged stress varied according to the patient's tolerance.

Relaxation of the surrounding muscles was essential, in our opinion, in order to perform these techniques. We attempted to minimize reflex muscle activity, which would cause resistance to the mobilization techniques. During treatment, reflex muscle activity was monitored by the therapist by means of palpation. Most of the time, changing the intensity or the direction of the mobilization technique was sufficient, in our opinion, to decrease the reflex muscle activity. Sometimes, we believed based on our palpation, it was necessary to move the shoulder once or twice through the whole ROM to obtain the necessary muscle relaxation.

We also used other techniques in an effort to improve the abduction in the glenohumeral joint. In a maximally abducted position, mobilizations were performed to improve the gliding of the humeral head caudally and anteriorly. Again, after 10 to 15 repetitions, the direction of gliding was altered by varying the position of the joint or the degree of rotation ("fine-tuning the mobilization"[37]).

A frequently used technique in our intervention sessions was glenohumeral distraction in different angles of abduction and flexion in the sagittal plane. The patient was positioned supine or side lying at the edge of the table. The cephalad hand of the therapist was placed on the humeral head just below the acromion while the patient's arm rested in the therapist's arm. The caudal hand of the therapist was placed on the lateral border on the scapula. While the cephalad hand attempted to maintain the desired angle of abduction or elevation, the caudal hand attempted to push the scapula in medial rotation. We believe that an advantage of this reversed distraction technique is the avoidance of unpleasant twisting of the soft tissues in the upper arm when the cephalad hand is the mobilizing hand (Fig. 1).

[FIGURE 1]

[*]Guerbet Nederland BV, PO Box 334, 4200 AH Gorinchem, the Netherlands
[†]Asta Pharmaceutica BV, PO Box 599, 2700 AN Zoetermeer, the Netherlands.

The patients were instructed to inform the therapist about any pain experienced during and after intervention. If the therapist believed that pain influenced the execution of the mobilization techniques in a negative way, the therapist altered the direction or degree of mobilization. If patients experienced a dull ache and the therapist believed there was no reflex muscle activity, mobilizations were continued. Patients were informed that this ache could last for a few hours after the treatment session. If the pain worsened or continued for more than 4 hours after intervention ("treatment soreness" [22]), the intensity of the mobilization techniques was decreased in the following session.

Patients were advised to use their involved shoulder in ADL tasks when possible. The patients were not instructed in home exercises to exclude the influence of their adherence to the exercise protocol. The duration of treatment was set at a maximum of 3 months.

OUTCOMES

Between t_0 and t_1, the patients were treated 2 times a week, with an average of 18 treatment sessions (SD= 3) (Tab. 2). Five patients reported no pain at the t_1 and t_2 assessments, but 2 patients reported pain during ADL and at night if they had lain on their affected shoulder. Six patients reported their overall progress after 3 months of therapy as "improved" or "much improved." Improvements were seen in pain levels and in ADL, especially overhead activities. One patient judged the result as "unchanged." Two patients had previously participated in sports and were able to resume their sporting activities as before. At the 9-month follow-up, 3 patients reported having "much improved" shoulder function, 3 patients reported having "improved" shoulder function, and 1 subject reported having "unchanged" shoulder function (Tab. 2).

[TABLE 2]

Range of Motion

Measurements of active and passive mobility of the affected and opposite shoulder joints are shown in Tables 3 and 4. The changes in the mean values over time indicate a substantial difference between the t_0 and t_1 measurements. The small differences between the t_1 and t_2 measurements indicate that the gain in mobility was maintained after 9 months. An example of individual changes for active flexion in the sagittal plane is shown in Figure 2. At the t_1 assessment, 5 patients had "excellent" results and 2 patients had "good" results for active mobility in the affected shoulder. At the t_2 assessment, all patients had "excellent" results. The improvement in passive range of motion was of the same magnitude as the improvement in active range of motion. The reliability of these measurements, however, is not known.

[TABLE 3-4]

[FIGURE 2]

Radiological Assessment

In 6 patients, we were able to compare the results of the progression in active abduction in the glenohumeral joint on a radiograph after 3 months of therapy. The glenohumeral abduction improved from an average of 93 degrees (SD = 19, range = 70–117) to an average of 129 degrees (SD = 21, range = 90–150). Individual changes are shown in Figure 3. The mean joint capacity at t_0 was 10 cm^3 (SD = 3, range = 6–15), and it increased to 15 cm^3 (SD = 3, range = 10–20) at t_1. On the second arthrogram, we observed an enlargement of the axillary recesses in 6 patients, whereas the axillary recesses did not change in 1 patient (Tab. 5). A partial rotator cuff tear was diagnosed at t_0 in 2 patients. One patient (patient 5) presented the same findings on the second arthrogram. In another patient (patient 3), the partial rotator cuff rupture was enlarged to a complete rotator cuff rupture, as demonstrated by the slow leakage of contrast fluid to the subacromial bursa after the measurement of the joint capacity.

[FIGURE 3]

[TABLE 5]

DISCUSSION

In a series of 7 patients with adhesive capsulitis, increases in joint capacity and glenohumeral mobility were observed after 3 months of treatment with EMTs. After finishing the treatments, all patients maintained their regained mobility at the 9-month follow-up. Six patients reported having "improved" or "much improved" shoulder function after 3 months of treatment and 9 months after treatment. Five patients reported no pain in the affected shoulder after 3 months of treatment and at the 9-month follow-up.

Symptoms of adhesive capsulitis develop over 6 months, may last 2 years, and then gradually disappear ("selflimiting character").[9,14,38] Sometimes, there may be longlasting pain and restricted motion.[11] Reeves[4] described the natural history of adhesive capsulitis and found a mean duration of the disease of 30 months (range = 12–42). As our patients' symptoms were present for at least 3 months, there is an indication that the changes seen after 3 months of treatment with EMTs could be attributed to the mobilization techniques rather than to the natural history of adhesive capsulitis. Limitations of our study were that we do not know about the reliability of our measurements and that there was no control group, so there is no way to know for certain that the improvement was not due to natural progression of the disease or to any of a variety of other causes.

Inclusion Criteria

In the acute phase of shoulder pain, it is difficult to distinguish adhesive capsulitis from other common shoulder pathologies such as rotator cuff tears, tendonitis, and calcify deposits.[5,6,25,39] These shoulder pathologies have similar symptoms such as pain at night or when lying on the affected shoulder, limited ROM, and compensatory excessive scapular movement for glenohumeral movement (a characteristic "girdle hunching maneuver"[19]). Many authors have described the etiology and clinical features of and therapy for adhesive capsulitis and disagree about the criteria for diagnosing this disease.[6] The criteria we used did not match those of any other study concerning mobilization techniques for adhesive capsulitis.[17,23–25]

Although arthrography is considered to be the best method to diagnose adhesive capsulitis,[16,25,36,40] no data are available on the reliability of measurements of joint capacity in an arthrographic procedure. Few investigators have used decreased joint volume as an inclusion criterion,[41] whereas some authors have justified the use of arthrography as the basis for establishing a definitive diagnosis of adhesive capsulitis in the context of doing clinical research.[6]

The purpose of applying EMTs in our patients was to stretch contracted periarticular structures. We believe that some time must pass before a capsular contracture with adhesions and consequently a diminished joint capacity develops, but the exact time span is not known. Reeves[4] stated that the duration of the first phase can vary from 2½ to 9 months. Therefore, it is difficult to determine the turnover from the first painful phase to the second phase in which a capsular contracture is apparent. End-range mobilization techniques can only be performed without causing too much pain if the inflammatory (first) phase has disappeared. In our study, therefore, arthrography was, for us, the key in diagnosing adhesive capsulitis and thus in timing the start of treatment of the capsular contracture with EMTs.

Mobilization Techniques

Nicholson[24] conducted a controlled study with 20 patients in 2 groups over a short period of time (4 weeks). In the experimental group, passive mobilization techniques were applied. In contrast to our study, Nicholson started his mobilizing techniques in a gentle way in the anatomical neutral position, progressing in later sessions toward the end of the ROM. A more specific description of the mobilization techniques was not reported by the author. Only the passive glenohumeral abduction in the experimental group increased after 4 weeks, and pain scores did not differ between groups.[24]

In a study by Bulgen et al,[23] 42 patients with frozen shoulder were assigned to 1 of 4 groups (a group that received steroids, a group that received mobilization, a group that received ice therapy, and a

group that received no treatment). Patients in the mobilization group were treated 3 times a week for 6 weeks and were instructed to perform pendular exercises regularly at home. The intensity of the mobilizations was not described. At 4 weeks, the major improvement in ROM occurred in the group treated with steroids, and Bulgen and colleagues concluded that local steroid injections should be the initial intervention of choice. At 6 months after treatment, no differences in ROM or pain were observed between the groups. Therefore, Bulgen et al concluded that there appears to be no place for physical therapy alone in the treatment of frozen shoulder and that it should not be continued for more than 4 weeks. Because half of the patients entered the study with a disease duration of less than 3 months and without confirmation of a diagnosis of adhesive capsulitis by arthrography, perhaps not all patients had adhesive capsulitis with capsular contractions. Due to the short treatment period and the lack of information about the performance of the mobilization techniques in these 2 studies,[23,24] it is difficult to draw conclusions.

The techniques we used were mostly performed at the end of the ROM with a high, sometimes painful, intensity. In contrast to the observations of other authors,[13,14,23,42,43] we saw no adverse effects on the recovery of patients with adhesive capsulitis treated with intensive (sometimes painful) mobilizations.

Measurement Outcome

In most studies, the most important outcome measures were ROM measured by means of a goniometer and a measure of pain. Both describe impairments in daily activities in a simple way and are not measures of function or disability. Some motions of the shoulder can be measured by goniometry with high intraobserver and intraobserver reliability, and this approach is common practice in orthopedics and physical therapy.[44,45] In evaluating the effect of treatment, having the same observer for measuring ROM is recommended.[46] In measuring shoulder motion with a conventional goniometer, it is difficult to determine the amount of glenohumeral mobility as part of the total range of abduction and flexion in the sagittal plane. Scapulothoracic compensation, even when the signs of the adhesive capsulitis are gone, cannot be estimated accurately. Therefore, we evaluated the results of EMTs on the glenohumeral joint by measuring angles on the radiographs between the humerus and the scapula with the arm in maximal active abduction.[35] This investigation of the amount of glenohumeral abduction is simple to perform and gives more detailed information about the position of the bony landmarks of the scapula than can be obtained by conventional goniometry, but the reliability of the measurements is not known.

We consider arthrographic measurements an important variable in the diagnosis of adhesive capsulitis. Negative aspects of the use of arthrography (and plain radiography) in diagnosis and evaluation of patients with frozen shoulders are that it incurs more expenses and that it exposes patients to radiation, and again we have no data about the measure's reliability. Measurements of the effective radiation during an investigation with antroposterior views of both shoulders and arthrography of the affected shoulder revealed an effective dose of 0.06 mSv.[47] Although the exposure to radiation during this intervention is quantified as very low, it must never be underestimated.[47]

In adhesive capsulitis, the structure to be treated presumably is the shoulder capsule.[20] It is important, therefore, to know whether the treatment has been effective on the structure itself.[48] Our results show an enlargement of the joint capacity in 6 out of 7 patients. These data should be interpreted with caution because there are, for ethical reasons, no control measurements of the opposite shoulder. Nevertheless, our data suggest that there may be structural changes of the shortened periarticular tissues. The tendency of the joint capacity to regain normal values has been described by Mao et al,[17] who found an increase in joint capacity in the shoulders of seven patients with frozen shoulders after treatment. In this study, the increase in joint space capacity was correlated with the improvement of ROM in lateral rotation. Follow-up arthrograms in the study of Mao et al showed reappearance or enlargement of the axillary recess and smoother capsular margins in 11 of 12 patients with frozen shoulder.[17] In our report, we focused on outcome measures at the level of impairments such as pain, decreased ROM, and decreased joint capacity. During the interviews conducted initially and at follow-up, the patients were asked about their difficulties in ADL. Initially, all patients complained about decreased function in ADL, housekeeping, work activities, and sports activities. Six patients reported improvements in overhead activities, lying on the affected shoulder, and personal care. Four patients who were employed were able to resume their work as usual after treatment. Two of them resumed

their participation in sport activities. These findings were not assessed by standardized questionnaires. We believe there is a need for controlled studies of treatment of frozen shoulders and for the use of validated questionnaires such as the Shoulder Disability Questionnaire or the Shoulder Rating Questionnaire.[49,50]

CONCLUSION

End-range mobilization techniques performed by physical therapists were used in an effort to increase mobility in patients with adhesive capsulitis of the shoulder. There was an increase of glenohumeral mobility, but in the absence of a control group, we cannot be sure what led to reduced impairment. Further investigation in the form of controlled studies is warranted to compare the therapeutic effect of these mobilizations with the natural course of the disease or other treatment regimens.

TABLES AND FIGURES

Table 1.
Demographic and Clinical Characteristics Initially for 7 Patients With Adhesive Capsulitis[a]

Patient No.	Sex	Age (y)	Side	Occupation	Duration of Complaints (mo)	No. of Previous Injections	No. of Physical Therapy Treament Sessions Before Enrollment in Study
1	F	45	n-D	Employee	12	0	34[b,c,d]
2	M	45	n-D	Metal worker	6	0	12[d,e]
3	M	55	n-D	Diability pension	10	1	12[b,d]
4	M	45	D	Manager	8	4	12[b,c,d]
5	F	65	D	Housewife	12	1	6[b,c,d]
6	F	56	n-D	Housewife	8	1	10[c]
7	M	41	D	Radiologist	3	0	0

[a] F=female, M=male, D=dominant side, n-D=nondominant side.
[b] Physical modalities.
[c] Gentle passive mobilizations.
[d] Active exercises.
[e] Massage.

Table 2.
Variables After 3 Months of Treatment (t_1) and 9 Months After Treatment (t_2)[a]

Patient No.	No. of Treatment Sessions With EMTs	Result of Active Glenohumeral Mobility		Presence of Pain		Patient's Opinion	
		t_1	t_2	t_1	t_2	t_1	t_2
1	14	I	I	No	No	++	++
2	14	II	I	No	No	++	++
3	17	II	I	No	No	+	+
4	21	I	I	No	No	++	++
5	22	I	I	Yes[b,c]	Yes[b,c]	±	±
6	20	I	I	Yes[b,c]	Yes[c]	+	+
7	19	I	I	No	No	++	+

[a] I=excellent: deficit of <20 degrees in abduction, flexion, and lateral rotation compared with the contralateral shoulder; II=good: deficit of 20 to 30 degrees in one or more directions; ++=much improved, +=improved, ±=unchanged; EMTs=end-range mobilization techniques.
[b] Pain during activities of daily living.
[c] Pain at night.

Table 3.
Active Abduction, Flexion in the Sagittal Plane, and Lateral Rotation (in Degrees) Assessed by Goniometry Initially (t_0), After 3 Months of Treatment (t_1), and 9 Months After Treatment (t_2) in 7 Patients With Adhesive Capsulitis

	t_0		t_1		t_2	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Abduction	91	16	151	22	161	17
Flexion	113	17	147	18	151	11
Lateral rotation	13	13	31	11	34	11

Table 4.
Passive Abduction, Flexion in the Sagittal Plane, and Lateral Rotation (in Degrees) Assessed by Goniometry Initially (t_0), After 3 Months of Treatment (t_1), and 9 Months After Treatment (t_2) in 7 Patients With Adhesive Capsulitis

	t_0		t_1		t_2	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Abduction	96	18	159	24	169	12
Flexion	120	16	154	19	159	14
Lateral rotation	21	11	41	8	43	10

Table 5.
Active Mobility and Radiologic Variables Initially (t_0), After 3 Months of Treatment (t_1), and 9 Months After Treatment (t_2)[a]

Patient No.	Active Lateral Rotation (°)			Active Flexion in the Sagittal Plane (°)			Active Abduction (°)			Active Glenohumeral Abduction on Radiograph (°)			Joint Capacity (cm^3)		Axillary Recess at t_1
	t_0	t_1	t_2	t_0	t_1	t_2	t_0	t_1	t_2	t_0	t_1	Reversed Side	t_0	t_1	
1	40	40	50	120	175	160	80	170	180	. . .	. . .	. . .	10	16	>
2	5	30	30	115	150	160	100	150	180	78	150	170	6	15	>
3	15	50	40	105	115	130	70	110	135	85	90	110	9	15	>
4	15	25	35	110	145	145	120	170	160	115	140	155	12	15	>
5	5	30	40	90	140	150	90	145	155	95	130	145	15	20	>
6	0	15	15	105	150	150	90	145	145	117	132	150	10	10	>
7	10	30	30	145	155	160	90	170	170	70	135	155	10	14	NC

[a] Ellipsis=missing values, >=enlarged, NC=no change.

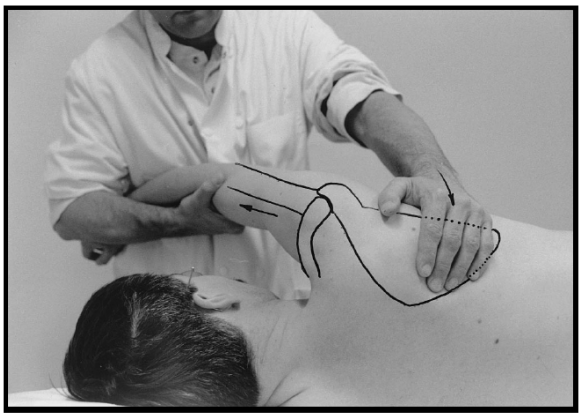

Figure 1.
Reversed distraction technique of the glenohumeral joint when patient lies on the nonaffected side. The scapula is mobilized in medial rotation while the position of the humerus is maintained.

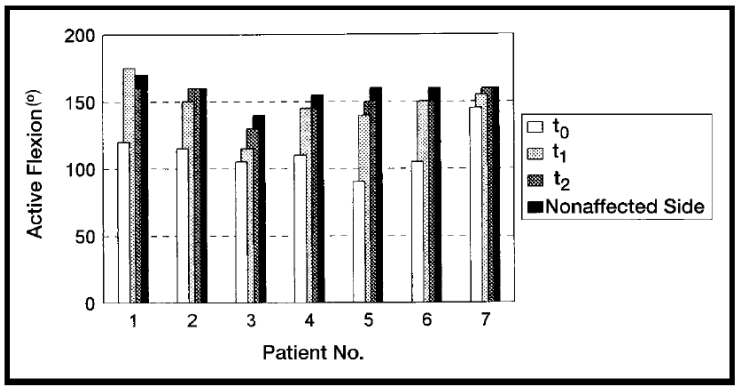

Figure 2.
Active flexion in the sagittal plane of the affected shoulder and active flexion in the sagittal plane of the nonaffected shoulder in 7 patients with adhesive capulitis treated with end-range mobilization techniques. Measurements were obtained before treatment began (t_0), after 3 months of treatment (t_1), and 9 months after treatment (t_2).

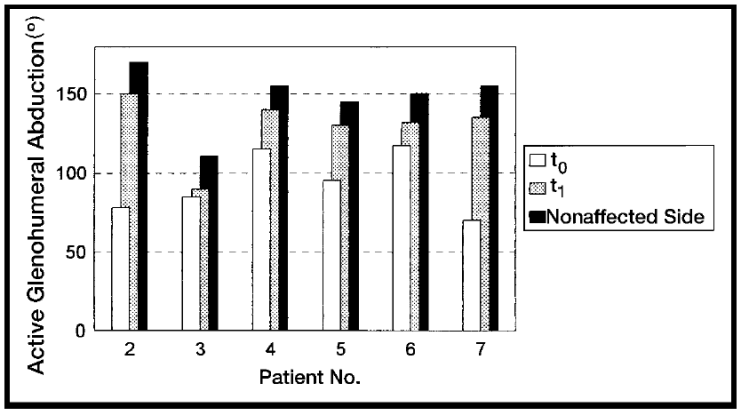

Figure 3.
Active glenohumeral abduction of the affected shoulder and the nonaffected shoulder in 6 patients with adhesive capsulitis treated with end-range mobilization techniques. Measurements were obtained before treatment (t_0) and after 3 months of treatment (t_1).

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