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Idiopathic Adhesive Capsulitis : A Prospective Functional Outcome Study of Nonoperative Treatment*

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Abstract

Background: Idiopathic adhesive capsulitis is a commonly recognized but poorly understood cause of a painful and stiff shoulder. Although most orthopaedic literature supports treatment with physical therapy and stretching exercises, some studies have demonstrated late pain and functional deficits. The purpose of this study was to evaluate the outcome of patients with idiopathic adhesive capsulitis who were treated with a stretching-exercise program.

Methods: Seventy-five consecutive patients (seventy-seven shoulders) with phase-II idiopathic adhesive capsulitis were treated with use of a specific four-direction shoulder-stretching exercise program and evaluated prospectively. The initial evaluation included the recording of a detailed medical and orthopaedic history and assessment of pain, range of motion, and function. The outcome evaluation included assessment of pain, range of motion, and function; completion of the Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire; and completion of the Short Form-36 (SF-36) Health Survey. The mean duration of follow-up was twenty-two months (range, twelve to forty-one months). One patient died prior to the final evaluation, and three patients were lost to follow-up.

Results: Sixty-four (90 percent) of the patients reported a satisfactory outcome. Seven (10 percent) were not satisfied with the outcome, and five (7 percent) underwent manipulation and/or arthroscopic capsular release. The outcomes of the patients who did not have manipulation or capsular release were evaluated. There were significant improvements in the scores for pain at rest (from a mean of 1.57 points before treatment to a mean of 1.16 points at the final evaluation; $p < 0.001$) and pain with activity (from a mean of 4.12 points before treatment to a mean of 1.33 points at the final evaluation; $p < 0.0001$). On the average, active forward elevation increased 43 degrees, active external rotation increased 25 degrees, passive

internal rotation increased eight vertebral levels, and the glenohumeral rotation arc at 90 degrees of abduction increased 72 degrees ($p < 0.00001$). The number of "yes" responses to the Simple Shoulder Test increased from a mean of 4.1 (of a possible twelve) to a mean of 10.75 ($p < 0.00001$). Despite the significant improvements and the high rate of patient satisfaction, there were still significant differences in the pain and motion of the affected shoulder when compared with those of the unaffected, contralateral shoulder ($p < 0.00001$).

At the final outcome evaluation, the DASH scores demonstrated limitations when compared with known population norms, whereas the profiles of the SF-36 were comparable with those of age and gender-matched control populations.

Prior treatment with physical therapy and a Workers' Compensation claim or pending litigation were the only variables that were associated with the eventual need for manipulation or capsular release. Male gender and diabetes mellitus were associated with worse motion at the final evaluation. Patients with a greater severity of pain with activity at the initial evaluation had significantly lower DASH scores at the final evaluation, and patients with lower initial scores on the Simple Shoulder Test had comparatively lower scores on the Simple Shoulder Test at the outcome evaluation.

Conclusions: The vast majority of patients who have phase-II idiopathic adhesive capsulitis can be successfully treated with a specific four-direction shoulder-stretching exercise program. Although measurable limitations and deficiencies were noted at the outcome evaluation, these appeared to be acceptable to most of the patients and did not affect their general health status. Patients with more severe pain and functional limitations before treatment had relatively worse outcomes. More aggressive treatment such as manipulation or capsular release was rarely necessary, and the efficacy of early use of these treatments should be further studied.

Introduction

Introduction | Materials and Methods | Results | Discussion | References

Adhesive capsulitis is a common but poorly understood syndrome of painful shoulder stiffness. Frozen shoulder syndrome was first described by Duplay in 18726. He used the term peri-arthritis scapulo-humerale and believed that manipulation under anesthesia had a role in its treatment. In 1934, Codman used the term frozen shoulder to describe this condition4. He stated that most cases resolved in about two years without treatment. In 1945, Neviaser coined the term adhesive capsulitis to reflect his findings at surgery and autopsy in patients treated for a painful, stiff shoulder17. More recently,

Zuckerman and Cuomo defined frozen shoulder, or idiopathic adhesive capsulitis, as a condition of uncertain etiology characterized by substantial restriction of both active and passive shoulder motion that occurs in the absence of a known intrinsic shoulder disorder33.

Although adhesive capsulitis is generally considered to be a self-limiting condition that can be treated with physical therapy, the best treatment has been the subject of extensive investigation10,25,28,30. A variety of different treatments have been recommended, and numerous studies have demonstrated successful results. The types of treatment have included benign neglect10, chiropractic manipulation22, oral corticosteroids3,24, injection of corticosteroids26,28, physical therapy exercises and modalities11,13,15,18, brisement7,8,27, manipulation under anesthesia12,18,21,24, and arthroscopic19,23,32 and open18,20 releases of the contracture. Recent studies have emphasized the surgical management of recalcitrant shoulder stiffness32. Many of these studies have been flawed because they have lacked objective and subjective outcome criteria.

The purpose of the present study was to prospectively evaluate the outcome of treatment of idiopathic adhesive capsulitis with a specific, supervised stretching-exercise program. Outcomes were determined by the assessment of subjective and objective parameters.

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+Fig. 1-A:: Photographs showing passive forward-elevation stretching with the patient supine.

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+Fig. 1-B:: Photographs showing passive forward-elevation stretching with the patient supine.

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+Fig. 2-A:: Photographs showing passive external-rotation stretching with the patient supine.

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+Fig. 2-B:: Photographs showing passive external-rotation stretching with the patient supine.

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+Fig. 3-A:: Photographs showing passive horizontal-adduction stretching with the patient supine.

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+Fig. 3-B:: Photographs showing passive horizontal-adduction stretching with the patient supine.

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+Fig. 4-A:: Photographs showing passive internal-rotation stretching.

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+Fig. 4-B:: Photographs showing passive internal-rotation stretching.

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Anchor for JumpAnchor for JumpTABLE I: Pain in Patients Treated Conservatively, without Manipulation or Capsular Release (Group I)*

Pain	Initial	Midterm (6-12 Wks.)	Final
At rest			
None (1 point)	37 (56)	38 (83)	53 (84)
Mild (2 points)	21 (32)	6 (13)	10 (16)
Moderate (3 points)	7 (11)	2 (4)	
Marked (4 points)	1 (2)		
Disabling (5 points)			

With activity			
None (1 point)	1 (2)	16 (36)	46 (73)
Mild (2 points)	1 (2)	15 (34)	13 (21)
Moderate (3 points)	14 (21)	7 (16)	4 (6)
Marked (4 points)	23 (35)	5 (11)	
Disabling (5 points)	27 (41)	1 (2)	

*The values are expressed as the number of patients, with the percentage in parentheses.Midterm responses were not available for all patients. In addition, two patients who responded to the question about pain at rest did not respond to the question about pain with activity.Three patients did not respond at the final evaluation.

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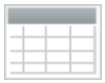
Anchor for JumpAnchor for JumpTABLE II: Shoulder Motion for Patients Treated Conservatively, without Manipulation or Capsular Release (Group I)

Direction of Motion	Affected Shoulder			Unaffected Shoulder
Initial	Midterm (6-12 Wks.)	Final		
Active forward elevation (degrees)	102	121	145	157
Active external rotation (degrees)	17	21	42	51
Passive internal rotation (vertebral level)	L4	L1	T8	T6
Passive forward elevation (degrees)	111		155	164

Passive external rotation (degrees)	19	51 65
Passive external rotation at 90 degrees of abduction (degrees)	13	60 83
Passive internal rotation at 90 degrees of abduction (degrees)	3	29 39
Total passive arc of rotation at 90 degrees of abduction (degrees)	16	88 119



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Anchor for JumpAnchor for JumpTable III: Statistical Analysis of the Effect of Extrinsic Factors on Outcome*

Extrinsic Factor	Change in Total Passive Arc of Rotation at 90 Degrees of Abduction		Pain			Simple Shoulder Test	Final DASH Score	Final SF-36 Score						
At Rest	With Activity	Change in Score	Total Final Score	Physical Function	Physical Role Function	Body Pain	General Health	Vitality	Social Function	Emotional Role Function	Mental Health			
Coronary artery disease	0.083	0.37	0.87	0.72	0.44	0.89	0.15	0.15	0.06	0.06	0.15	0.21	0.44	0.79

Previous

surgery													
Upper extremity	0.92	0.4	0.81	0.86	0.021	0.86	0.013	0.004	0.023	0.020	0.021	0.76	0.44	0.42
Breast	0.57	0.4	0.29	0.35	0.14	0.25	0.96	0.57	0.96	0.24	0.21	0.67	0.16	0.53
Diabetes mellitus	0.29	0.22	0.81	0.94	0.31	0.19	0.37	0.51	0.83	0.34	0.24	0.46	0.95	0.63
Hypothyroidism	0.51	0.33	0.007	0.93	0.87	0.73	0.73	0.88	0.28	0.74	0.61	0.10	0.31	0.95
All factors	0.040	0.1	0.29	0.39	0.26	0.17	0.04	0.03	0.016	0.011	0.29	0.86	0.98	0.69

*The values indicate p values, with the significant ones in bold.

Materials and Methods

Inclusion Criteria

Between September 1993 and September 1996, seventy-five consecutive patients with phase-II idiopathic adhesive capsulitis16 were evaluated prospectively by the senior author (A. G.). Phase-II idiopathic adhesive capsulitis was defined as the stage of involvement in which the patient had pain and globally limited shoulder motion. No attempt was made to specifically recruit patients for inclusion in this study.

The criteria for inclusion in the study were (1) no or only trivial shoulder trauma, (2) marked loss of active and passive shoulder motion (greater than a 50 percent loss of external rotation) especially with the shoulder abducted 90 degrees, (3) pain at the extremes of all motions, (4) globally limited glenohumeral translation, and (5) normal findings on true anteroposterior and axillary lateral radiographs of the glenohumeral joint. Patients with adhesive capsulitis and extrinsic disorders such as cervical spine pathology, cardiopulmonary conditions, and systemic disorders (for example, diabetes mellitus and thyroid dysfunction) were included in the study (Table III). We included all patients with idiopathic atraumatic adhesive capsulitis so that we could analyze the effect of extrinsic conditions on the outcome of nonoperative treatment. Just as the pathophysiology of idiopathic adhesive capsulitis is poorly understood, so are the effects of extrinsic conditions. Few prior studies have addressed this issue, and we thought that our study would afford us the opportunity to do this.

The exclusion criteria included (1) intrinsic glenohumeral pathology such as glenohumeral arthritis, (2) a history of substantial shoulder trauma, (3) previous shoulder surgery, (4) initiation of successful treatment within six weeks before the initial evaluation by the senior author, and (5) reflex sympathetic dystrophy.

Patient Demographics

Fifty-eight (77 percent) of the patients were female, and seventeen (23 percent) were male. The mean age was fifty-three years (range, thirty-five to seventy-six years). There was no significant difference between the ages of the male and female patients ($p = 0.64$). The dominant shoulder was involved in thirty (40 percent) of the patients, and the nondominant shoulder was involved in forty-five (60 percent). The left shoulder was involved in forty-four patients (59 percent). Two patients (3 percent) had concurrent bilateral involvement, and consequently seventy-seven shoulders were included in the study. Four patients (5 percent) had had contralateral idiopathic adhesive capsulitis previously. Twenty-two patients (29 percent) had a history of trivial shoulder trauma that they related to the onset of the symptoms. Five patients (7 percent) had a Workers' Compensation claim or pending litigation.

The mean duration of shoulder pain prior to the initial evaluation by the senior author was 9.2 months (range, 1.3 to forty-seven months). The duration of shoulder stiffness could not be determined because the findings of previous physical examinations were not available and it was impossible to determine when stiffness began in the course of the adhesive capsulitis.

Forty-six shoulders (60 percent) had had previous unsuccessful treatment. Twenty-five shoulders (32 percent) had undergone only a course of physical therapy, and seven (9 percent) had had only a corticosteroid injection. Fourteen shoulders (18 percent) had had both physical therapy and a corticosteroid injection. Although we were unable to precisely determine the details of the prior physical therapy, it usually included ultrasound, heat, massage, and active exercises rather than passive stretching. Similarly, we were unable to definitively determine whether the injections were intra-articular or subacromial. One of the patients had had two manipulations under anesthesia prior to our evaluation. Thirty-one shoulders (40 percent) had not had previous treatment.

Eight patients (11 percent) had diabetes mellitus, and seven (9 percent) had hypothyroidism. Six (8 percent) had coronary artery disease, and three of them had undergone coronary artery bypass grafting. One patient had myasthenia gravis. Forty-two (72 percent) of the women were postmenopausal.

Fourteen patients (19 percent) had another condition or had had surgery that involved the affected upper extremity or shoulder girdle. One patient had had recent carpal tunnel surgery. Two other patients had symptoms of carpal tunnel syndrome. One patient had had an ipsilateral anterior subcutaneous ulnar nerve transposition immediately before the onset of the shoulder stiffness. Four patients related a history of previous "frozen shoulder" involving the same extremity. Five patients had undergone ipsilateral breast surgery just prior to the onset of symptoms of frozen shoulder. One had a history of poliomyelitis involving the affected side.

Advanced shoulder imaging had been performed by another physician for twelve patients prior to our initial evaluation. One patient had a computerized tomographic arthrogram that revealed normal findings. Eleven patients had magnetic resonance imaging of the shoulder; six of these studies revealed normal findings, three suggested a partial-thickness supraspinatus tear, one showed a small full-thickness rotator cuff tear, and one suggested an anterior labral tear. The patients with a partial-thickness tear did not have relief of shoulder pain or stiffness after subacromial injection with ten centiliters of 1 percent plain lidocaine. The patient with a full-thickness rotator cuff tear did not require rotator cuff repair. The patient with a labral tear had eventual failure of our treatment protocol and underwent shoulder arthroscopy. Arthroscopic evaluation demonstrated only mild anterior labral fraying. Thus, none of the pathological findings on these five magnetic resonance imaging scans were clinically relevant. It was for this reason that we included these patients, despite the pathological findings identified by the magnetic resonance images. All of these patients had markedly limited passive glenohumeral motion that otherwise fit the inclusion criteria for this study.

Evaluation

The initial evaluation included the recording of a detailed medical history with attention directed at the identification of relevant comorbidities, the recording of a history of the shoulder disorder, physical examination, completion of a subjective pain questionnaire, and subjective functional evaluation with use of the Simple Shoulder Test. Plain radiographs were made in the true anteroposterior and axillary lateral projections. Follow-up evaluations were performed at six-week intervals until either the patient clearly had enough improvement for routine follow-up to be discontinued or the treatment protocol had failed.

At the initial evaluation and at each follow-up visit, the patient was asked to rate pain at rest and with activity according to a scale in which no pain was assigned 1 point; mild pain, 2 points; moderate pain, 3 points; marked pain, 4 points; and disabling pain, 5 points.

Active and passive shoulder motion was measured with a large handheld goniometer. Bilateral active motions were assessed simultaneously with the patient in the seated position. Active forward elevation in the scapular plane was evaluated by measuring the angle formed by the arm and thorax. Active external rotation was evaluated with the arm adducted and the elbow at the side and flexed to 90 degrees. Passive internal rotation of the arm behind the back was assessed by determining the vertebral level that could be reached by the tip of the thumb. All other passive shoulder motions were assessed with the patient supine. This position limits the contribution of scapulothoracic motion to overall shoulder motion. Passive forward elevation was determined by measuring the angle formed by the arm and thorax. Passive external rotation was measured with the arm at the side and the elbow flexed 90 degrees. Passive shoulder rotation was measured with the shoulder abducted to 90 degrees. The total passive arc of rotation in this position was calculated. When the arm could not be abducted to 90 degrees the arc was considered to be 0 degrees.

Shoulder strength was evaluated with manual muscle-testing. A more detailed or precise strength evaluation was not carried out because adhesive capsulitis is not generally considered to be a cause of

shoulder weakness. In addition, it is impossible to assess rotator cuff strength accurately when glenohumeral motion is limited.

The Simple Shoulder Test was used to assess the patient's subjective comfort and the ability to perform twelve activities at the initial and final evaluations. Matsen et al. demonstrated the ease of use and reproducibility of this test14. They found that patients between the ages of sixty and seventy years who had normal shoulders responded "yes" to all of the questions nearly all of the time.

Treatment Protocol and Determination of Failure

All patients were treated with the same rehabilitation exercise protocol. This included pendulum circumduction and passive shoulder-stretching exercises in forward elevation, external rotation, horizontal adduction, and internal rotation (FIg. 1-A, FIg. 1-B, FIg. 2-A, FIg. 2-B, FIg. 3-A, FIg. 3-B, FIg. 4-A, and FIg. 4-B). The patient was provided with instructions for these exercises and was referred for formal physical therapy. The patient was instructed to stretch the shoulder to the point of tolerable discomfort five times each day. On the average, the patients reported performing home exercises twice each day. Sixty-eight patients (91 percent) participated in a formal physical therapy program that emphasized these passive stretching exercises. On the average, they attended physical therapy sessions twice each week. We recommended formal physical therapy sessions to teach the exercises. Unfortunately, we had little control over the actual number of formal sessions, which tended to be determined by the individual therapists.

We considered the treatment to have failed when the patient was dissatisfied with the status of the shoulder. This determination was based upon the patient's report and not on our impression of the shoulder's status. Most patients reported minimal reduction of shoulder pain at three months after the initial evaluation. The final determination of failure of treatment was made at the time of the data analysis.

We did not specifically prescribe the use of oral nonsteroidal anti-inflammatory medications or discourage or prohibit patients from taking them. Specific strengthening exercises were deferred until the shoulder pain was reduced and the shoulder motion had improved. More aggressive treatment (manipulation or capsular release) was not recommended until the protocol had failed (the patient was dissatisfied with the outcome) after it had been tried for three months or longer.

Outcome Assessment

At the final evaluation, the subjective outcome was assessed by querying the patients about whether they were satisfied with the outcome of the treatment of their shoulder and whether they thought that they were much better, better, the same, or worse compared with their status before treatment. The Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire1 and the Short Form-36 (SF-36) Health Survey31 were used at the final outcome evaluation to compare the patients with each other and with established population norms. The patients who were lost to follow-up or had undergone a procedure to increase shoulder motion (manipulation under anesthesia or arthroscopic capsular release) were not evaluated with these questionnaires.

All of the patients had their final evaluation as part of the outcome study. The duration of follow-up was dependent upon our ability to coordinate the evaluations of the majority of patients who had stopped returning for routine follow-up evaluations.

For the purpose of the outcome analysis, two groups of patients were considered. Group I included all of the patients who were managed with the treatment protocol except for those who had been managed with manipulation under anesthesia or capsular release. This group included patients who were not satisfied with the outcome of the treatment protocol if they had not had additional treatment. Group II consisted of the patients who were not satisfied with the outcome and went on to have manipulation under anesthesia or capsular release. The combination of Groups I and II included all of the patients.

The results were analyzed with two major goals in mind. The first was to assess the outcomes in Group I (the patients who did not have manipulation or capsular release). Pain, range of motion, and functional ability before and after treatment were compared, and the associations between demographic variables and the findings on the initial evaluation, the subjective outcomes, and the DASH scores were analyzed. Additionally, the DASH and SF-36 scores of these patients (Group I) were compared with published population norms. All of the patients in Group I who were eventually satisfied with the outcome had been satisfied with their progress after three months of the treatment protocol. We did not determine the duration to the final result, as most of the patients did not continue returning for routine follow-up once they began to have resolution of their symptoms.

The second goal was to analyze the demographic variables and the findings, at the initial evaluation, with respect to pain, range of motion, and the results of the Simple Shoulder Test for the patients in Group II in order to identify predictors of unsatisfactory outcome.

Statistical Analysis

The paired t test was used to analyze shoulder motion and responses to the Simple Shoulder Test. The Wilcoxon signed-rank test was use to analyze pain at the various evaluation intervals. Associations between various initial and outcome parameters were analyzed with use of the Pearson product-moment correlation, Spearman, Mann-Whitney U, and Kruskal-Wallis tests. P values of less than 0.05 were considered significant.

Results

The mean duration of follow-up was twenty-two months (range, twelve to forty-one months). One patient died prior to the final evaluation, and three patients were lost to follow-up. Fifty-nine (77 percent) of the shoulders (fifty-seven patients) had complete follow-up, including physical examination and outcome assessment. Fourteen (19 percent) of the patients who did not return for final physical examination participated in an evaluation of pain and satisfaction and completed the outcome

evaluation questionnaire over the telephone. The range of motion was not determined for the patients who were evaluated by telephone.

Group I, the patients who did not undergo manipulation under anesthesia or capsular release, included sixty-six patients. Group II, the patients who had manipulation under anesthesia or capsular release, included five patients.

Pain

The patients' evaluations of pain at rest and pain with activity are summarized in Table I. In Group I, the mean score for pain at rest decreased from 1.58 points at the initial evaluation to 1.16 points at the final evaluation ($p < 0.001$), and the mean score for pain with activity decreased from 4.12 to 1.33 points ($p < 0.0001$).

The pain scores at the midterm evaluation (six to twelve weeks after the initial evaluation) were available for forty-six patients (Table I). These data included the scores for the patients who eventually underwent manipulation or arthroscopic capsular release. The mean score for pain at rest was 1.2 points, and the mean score for pain with activity was 2.1 points. The scores for pain at rest ($p < 0.0001$) and with activity ($p < 0.001$) at the midterm evaluation were significantly lower than those at the initial evaluation.

In Group I, the severity of the initial pain at rest and with activity was not associated with the final subjective outcome. Similarly, the severity of the initial pain at rest was not associated with the final DASH score ($p = 0.083$). In contrast, the initial pain with activity in Group I was associated with a greater (worse) final DASH score ($p = 0.0235$).

Shoulder Motion

The active and passive ranges of motion of the affected shoulder in Group I at the initial and final evaluations are summarized in Table II. There was a significant increase in all ranges of motion at the final evaluation ($p < 0.00001$). Nevertheless, the final range of motion of the affected shoulder was significantly less than the motion of the unaffected shoulder ($p < 0.00001$) (Table II). Despite this difference, the ratio of the initial motion to the final motion was not significantly associated with the final subjective assessment of pain, the subjective outcome, or the final DASH score. Similarly, there was no significant association between the improvement in range of motion and the outcome with respect to pain, function (Simple Shoulder Test), or the DASH or SF-36 score.

Diabetes mellitus and male gender were the only variables associated with greater limitations of final motion ($p < 0.01$).

Functional Evaluation

In Group I, sixty-three patients responded to the Simple Shoulder Test. The mean number of "yes" responses to the Simple Shoulder Test increased from 4.1 at the initial evaluation to 10.75 at the

outcome evaluation ($p < 0.00001$). Even at the midterm evaluation, there was significant improvement, to 7.0, in the mean number of "yes" responses ($p < 0.00001$).

At the final outcome evaluation, all of the patients were comfortable with the arm at the side and could reach the small of the back to tuck in their shirt. Only two patients were unable to return to their usual work, one patient was unable to sleep comfortably, and one was unable to place a coin on a shelf at the level of the shoulder without bending the elbow.

At the final evaluation, twenty-seven (43 percent) of the sixty-three patients who responded had less than twelve "yes" responses to the Simple Shoulder Test. These patients had had a mean of 3.15 "yes" responses before treatment, whereas the patients who had all "yes" responses at the final outcome evaluation had had a mean of 4.67 "yes" responses before treatment. There was a positive trend for an association between the numbers of "yes" responses at the initial and final evaluations ($p > 0.05$ and < 0.10, respectively).

Assessment of the negative responses to the Simple Shoulder Test at the final outcome evaluation revealed that, of the sixty-three patients, twenty (32 percent) were unable to throw a ball overhead a distance of thirty yards (27.4 meters), eleven (17 percent) were unable to lift eight pounds (3.6 kilograms) to the level of the shoulder without bending the elbow, eleven were unable to carry twenty pounds (9.1 kilograms) at the side, eight (13 percent) were unable to toss a softball underhand ten yards (9.1 meters), and eight were unable to wash the back of the contralateral shoulder.

In Group I, there was no significant association between the responses to the final Simple Shoulder Test and the final range of motion of the affected shoulder. Similarly, there was no association between the improvement in the range of motion and the responses to the Simple Shoulder Test.

Outcome Evaluation

Satisfaction with the outcomes was determined by questioning the patients. Ninety percent (sixty-four) of the patients (sixty-six shoulders) considered the outcome of the nonoperative treatment protocol to be satisfactory. Forty-nine (67 percent) of the seventy-three shoulders were considered to be much better, twenty-one (29 percent) were thought to be better, and three (4 percent) were considered to be unchanged. No shoulder was worse after the nonoperative treatment. Two patients who were not satisfied elected not to have additional treatment. Interestingly, contralateral idiopathic adhesive capsulitis developed in three patients (4 percent) during the follow-up period. In total, nine (13 percent) of the patients in this study had bilateral idiopathic adhesive capsulitis.

Five (7 percent) of the original seventy-one patients who were available for outcome evaluation were not satisfied with the result of the treatment protocol and elected to undergo a procedure to increase shoulder motion at a mean of six months (range, three to thirteen months) after our initial evaluation. Two of these patients had had improvement after nonoperative treatment but still elected to have arthroscopic capsular release. Both had additional improvement after this intervention. One patient who did not have improvement after nonoperative treatment had a successful manipulation under

anesthesia. Two patients who had manipulation and arthroscopic capsular release did not have improvement after this intervention.

Both of the patients for whom the nonoperative and operative treatment failed were diabetic. One did not seek additional treatment. The other went to another physician and had another manipulation under anesthesia, which decreased the symptoms.

Demographic variables were specifically analyzed for any association with subjective dissatisfaction and the eventual need for manipulation or capsular release (Group-II patients). Previous treatment with physical therapy ($p = 0.028$) and a Workers' Compensation claim or litigation ($p < 0.001$) were the only variables associated with failure or eventual manipulation or capsular release. Treatment failure and the need for manipulation or capsular release were not associated with age, menopause, duration of symptoms, the shoulder that was affected, trivial trauma, medical comorbidities, initial pain, responses to the Simple Shoulder Test, or range of motion.

The effect of several extrinsic factors on the outcome was assessed (Table III). We analyzed the effect of coronary artery disease, previous surgery, diabetes mellitus, and hypothyroidism as well as the combined group of extrinsic factors.

The mean DASH score at the final evaluation of the patients managed conservatively (Group I) was 9.7 ± 13.6 points. The established mean normal values for the DASH score are between 3 and 6 points (Dorcas Beaton, personal communication, 1997). Fifty-two percent of the patients in Group I had a DASH score of less than 3 points, and 61 percent had a score of less than 6 points. Thus, nearly 40 percent of the Group-I patients had an abnormally high DASH score (more than 6 points). The mean DASH score for patients with a rotator cuff tear (about 27 points [Dorcas Beaton, personal communication, 1997]) was used as a relevant comparison. Twelve percent of the patients in Group I who considered the shoulder to be improved had a DASH score of greater than 27 points.

There was no significant association between the final score for pain at rest and the DASH score ($p = 0.082$). However, there was a significant association between the initial score for pain with activity and the DASH score ($p = 0.0235$) and a highly significant association between the final score for pain with activity and the DASH score ($p < 0.0001$).

The eight profiles of the SF-36 Health Survey completed by the patients in Group I were compared with values in the normal population (both the general population and appropriate age and gender-matched populations). The mean scores in Group I were never lower than the published population norms. When compared with the general population, the patients in Group I had a significantly higher mental health score ($p = 0.04$). All of the other profiles were not significantly greater than those for the general population. The scores for the men in Group I were not significantly different from those in the general male population. The women in Group I had significantly better scores for vitality ($p = 0.012$) and mental health ($p = 0.049$), as well as a trend toward greater scores on all of the other profiles, compared with the general female population.

Discussion

In this study, we prospectively evaluated the subjective and objective outcomes of the treatment of idiopathic adhesive capsulitis with a specific shoulder-stretching exercise program. The vast majority of patients with this condition were successfully treated. The measurable limitations and deficiencies at the outcome evaluation were acceptable to most of the patients and did not appear to affect their general health status. We concluded that most cases of idiopathic adhesive capsulitis can be treated with shoulder-stretching exercises. In this study, this was true even in many patients who had had prior treatment attempts with physical therapy and corticosteroid injections.

Although previous, retrospective studies15,29 have also demonstrated that patients who recover from adhesive capsulitis have residual limitations, those studies failed to document the extent of improvement and patient satisfaction that occurred. Our prospective study provided data that enabled us to analyze the reduction in pain and improvement in function as well as to document the limitations and general health status at the time of final follow-up. Consequently, the somewhat pessimistic view expressed by authors of retrospective studies about the outcome of idiopathic adhesive capsulitis can be compared with the marked improvements and overall satisfaction that we observed.

Despite the success of treatment with a specific stretching exercise program, there were measurable differences between the affected and unaffected shoulders. Even among the patients who were satisfied, a substantial number were not pain-free. Ten percent had mild pain at rest, and 27 percent had mild or moderate pain with activity. We also found significant differences between the involved and uninvolved shoulders with regard to all ranges of active and passive shoulder motion at the final evaluation. Additionally, the responses to the Simple Shoulder Test were not normal. However, there was no association between the final range of motion and shoulder function as measured by the Simple Shoulder Test. This latter finding is probably valid because small differences in ranges of motion are not likely to substantially affect functional capacity.

Furthermore, despite the high rate of satisfaction, the results of the DASH Questionnaire demonstrated that nearly 40 percent of the satisfied patients had abnormal shoulder function. This finding indicates that completely normal function of the shoulder and upper extremity is not a prerequisite for patient satisfaction. Most importantly, a patient's perception of outcome is relative not only to the normal shoulder but also to the change in pain and function as a result of the treatment. The amount that the affected shoulder is improved compared with the preoperative status probably affects the subjective perception of outcome. This is particularly true if "normal" is not the expected outcome.

Review of the previous literature on adhesive capsulitis demonstrates controversy about which of the many available treatments is best3,7,8,11-13,15,16,18,19,21-24,26,27,29,32. This controversy is due, in part, to a failure of many authors to precisely define and accurately identify idiopathic adhesive capsulitis among other causes of shoulder pain and stiffness. Many studies have emphasized some form of invasive therapy, including corticosteroid injection, brisement, manipulation under anesthesia, and arthroscopic and open releases. Additionally, many of the studies have addressed the treatment of

recalcitrant adhesive capsulitis. It is difficult to determine when adhesive capsulitis is recalcitrant, especially if the initial treatment modality is not efficacious. In our study, we clearly defined our patient population and we prospectively evaluated the patients.

Our results are consistent with the findings reported by Shaffer et al. in a long-term retrospective study29. Fifty percent of their sixty-two patients reported having either mild pain or stiffness at the time of follow-up. Miller et al. also reported the long-term results of an orthopaedist-directed home rehabilitation program15. Although they stated that all of their patients regained significant motion and returned to activities of daily living without pain, they did not compare the results with the status of the unaffected shoulder.

The results of the SF-36 Health Survey did not demonstrate significantly lower scores for the satisfied patients compared with the general population. This finding suggests that this survey is not sensitive enough to detect some major abnormalities of the shoulder and upper extremity. It also suggests that patients who overcome adhesive capsulitis do not have an intrinsic emotional, psychological, or personality disorder as has been suggested by some authors5,9.

We attempted to identify the variables that have prognostic importance for the treatment of idiopathic adhesive capsulitis. However, the high rate of satisfaction rendered a statistical analysis of variance difficult. Nevertheless, we identified variables that seemed to be associated with some of the outcome parameters. There was a trend toward worse results among men and among patients with diabetes. In addition, we found that patients with adhesive capsulitis were generally comfortable at rest and that pain with activity was associated with function. This is supported by our finding that the level of pain with activity at the outcome evaluation was associated with the functional outcome while the final range of motion and improvement in the range of motion were not.

This study also demonstrated that the level of self-reported pain with activity and function during the most severe phase of adhesive capsulitis is associated with the outcome of treatment. Even the patients who were satisfied had consistent perceptions of self-reported pain with activity and function between the initial and final evaluations - that is, the patients who had the worst perceptions of the shoulder before the treatment tended to have the worst outcomes. This is a crucial finding that has not been previously identified in studies of adhesive capsulitis, to our knowledge.

We made no attempt to compare the effectiveness of the various available treatment options, and the prescribed protocol was followed unless the patient requested an alternative treatment. The decision to perform a manipulation under anesthesia or an arthroscopic capsular release was delayed until the shoulder had failed to improve despite at least three months of the treatment protocol.

On the basis of the findings of our study, we recommend that patients with phase-II idiopathic adhesive capsulitis should be treated with a four-direction shoulder-stretching exercise program that includes passive forward elevation, passive external rotation, passive internal rotation, and passive horizontal adduction. This treatment should be continued for at least three months before more aggressive or invasive management is considered. Our experience indicates that a significant reduction in pain and improvement in function should be expected by three months and the vast majority of shoulders should

have a satisfactory outcome. Consequently, we do not recommend a more accelerated treatment protocol. Although our patients agreed to this protocol, we recognize that the treating physician can have substantial influence on the patient's expectations and treatment preference. We caution against inappropriate early manipulation or surgical intervention. When our treatment protocol failed, the success of manipulation or arthroscopic capsular release was limited.

To our knowledge, this is the first prospective study of idiopathic adhesive capsulitis to provide detailed information about the level of pain, active and passive range of motion, and functional outcome of nonoperative treatment. The results clearly demonstrate that the vast majority of patients with phase-II idiopathic adhesive capsulitis can be effectively treated with a specific shoulder-stretching exercise program. When the final outcome was assessed, all of the parameters evaluated were found to be significantly improved and 90 percent of the patients were satisfied.

This study defined outcomes in terms of patient self-assessment rather than categorical ranking. This type of information is critically important when determining the management of any musculoskeletal condition. The results of this study provide a basis for treatment of phase-II idiopathic adhesive capsulitis as well as an estimate of the expected outcome and identify significant prognostic factors. We believe that the efficacy of early use of more aggressive or invasive treatments should be studied further before widespread utilization is advocated.

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