Positional Stretching of the Coracohumeral Ligament on a Patient with Adhesive Capsulitis: A Case Report

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Idiopathic frozen shoulder, commonly known as adhesive capsulitis, is a condition of uncertain etiology characterized by a progressive loss of both active and passive shoulder motion¹. The complete loss of external rotation is the single most important factor in differential diagnosis². Three stages of frozen shoulder have been identified: painful freezing, adhesion, and resolution². Table 1 depicts the clinical presentations of each stage². Cyriax³ described the typical capsular pattern seen in frozen shoulder as external rotation being the most limited. Pain, particularly in the first phase of adhesive capsulitis, often keeps pa-

tients from performing activities of daily living⁴.

Various treatment approaches have been described for limited shoulder passive range of motion (ROM)⁵. These approaches include different forms of manual therapy, electrotherapy, active exercise, and several forms of passive stretching⁵. Previously published prospective studies of effective treatment approaches for gaining shoulder ROM in patients with frozen shoulder have demonstrated conflicting results⁶. The use of passive stretching of the shoulder capsule and soft tissues by means of mobilization techniques has been recommended, but

limited data supporting the use of these techniques are available⁶. In a systematic review, Green et al⁷ concluded that there is no evidence that physical therapy without concurrent interventions such as corticosteroid injections is of benefit for adhesive capsulitis. According to Vermeulen et al⁸, the effectiveness of mobilization techniques of various intensities in improving shoulder ROM and function is still unknown. In a randomized multiple treatment trial, Yang et al¹ found end-range mobilization and mobilization-with-movement to be statistically more effective in increasing shoulder external rotation than mid-range mobilization. In another randomized controlled trial, Vermeulen et al⁸, found high-grade mobilization techniques as described by Maitland⁹ to be more effective than low-grade mobilizations in the management of adhesive capsulitis; however, only a minority of comparisons reached statistical significance as both groups improved with both strategies. In another randomized clinical trial, Zimmerman et al¹⁰ found posteriorly directed joint mobilization more effective than anteriorly directed mobilization for improving external rotation in subjects with adhesive capsulitis.

Thickening of the joint capsule and the axillary recess has been described as a characteristic of frozen shoulder¹¹ although other researchers^{12,13} have contrasted these statements, pointing to the

ABSTRACT: Idiopathic frozen shoulder is a common medical diagnosis for patients seeking physical therapy. Radiographic and surgical evidence exists that describes the coracohumeral ligament (CHL) as a major contributor to lack of external rotation in patients diagnosed with frozen shoulder. No stretching techniques targeting the anatomical fiber orientation of the CHL have been reported in the literature. This single-patient case-report describes the use of a positional stretching technique of the CHL on a 51-year-old female diagnosed with phase I frozen shoulder. The patient completed 8 in-office visits and 17 home exercise program sessions of positional CHL stretching combined with a simple volitional rotator cuff exercise program in a 4-week period. The patient's Disabilities of the Arm Shoulder and Hand (DASH) scores improved from 65 to 36 and Shoulder Pain and Disability Index (SPADI) scores improved from 72 to 8 and passive external rotation from 20° to 71°. While a cause-and-effect relationship cannot be inferred from a single case, this report may foster further investigation regarding the role of the CHL in patients with stage-I and stage-II frozen shoulder as well as therapeutic strategies to help reduce loss of mobility and function.

KEYWORDS: Coracohumeral Ligament, Frozen Shoulder, Positional Stretching

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TABLE 1. The three stages of adhesive capsulitis also known as frozen shoulder

Stage I: Painful Freezing	Stage II: Adhesion	Stage III: Resolution
Pain and stiffness around the shoulder with no history of injury.	The pain gradually subsides but the stiffness remains.	Follows the adhesive phase with spontaneous improvement in range of motion.
A nagging and constant pain that is worse at night.	Pain is apparent only at the extremes of movement.	
Little response to non-steroidal anti-inflammatory drugs.	Gross reduction of glenohumeral motion, with near total obliteration of external rotation.	
May last between 10–36 weeks.	May last between 4–12 months.	May last between 12–42 months.

fibroblast proliferation and thickening of the coracohumeral ligament (CHL) and the capsule at the rotator cuff interval, and the complete obliteration of the fat triangle under the coracoid process as the most characteristic MRI findings in frozen shoulder instead of the axillary recess. The CHL divides into two major bands, one that inserts into the supraspinatus tendon and the greater tuberosity and the other that inserts into the subscapularis tendon and the lesser tuberosity¹⁴. According to Desai¹⁵, the inability to locate the area of pathology has been the primary cause for the lack of effective and predictable treatment; Desai also noted that the primary area of pathology in frozen shoulder seems to be the CHL and the rotator interval.

Although evidence exists in the physical therapy literature pertaining to the evaluation and treatment of frozen shoulders, research is lacking on the contribution and effects of CHL positional stretching on a patient with stage-I frozen shoulder. Specifically, to date, no studies have investigated positional stretching techniques that follow the anatomical fiber orientation of the CHL and the area of the rotator cuff interval in this population. The primary purpose of this single-patient case report is to describe outcomes of a positional stretching technique following the anatomical orientation of the two bands of the CHL and rotator interval capsule in a patient with this condition. In an attempt to ensure a *clean* case, patients diagnosed with secondary frozen

shoulder, diabetes, and other co-morbidities such as rotator cuff pathology or traumatic fractures were excluded.

Patient Characteristics

The patient was a 51-year old-married, right-handed, female employed as a coder in a physician's office. Medical history was unremarkable and denied any trauma to her left shoulder. The patient was referred for physical therapy with a diagnosis of left frozen shoulder. The symptoms began insidiously and progressed rapidly six weeks prior to initial visit with the physical therapist. Two weeks after the onset of symptoms, the patient decided to seek medical attention and went to a clinic where she was evaluated and had a magnetic resonance image (MRI) performed on her shoulder. The MRI demonstrated mild synovitis in the bicipital tendon; the rotator cuff was intact. Initial medical treatment consisted of naproxen, a nonsteroidal anti-inflammatory medication (NSAID). The patient, however, continued to have further loss of active and passive shoulder ROM. The patient received a corticosteroid injection one week prior to the start of physical therapy. The patient reported obtaining moderate relief of pain from the steroid injection, pain levels reducing to 5/10 from 10/10 on a numerical verbal scale rating¹⁶. She did not obtain any gains in active or passive ROM after the corticosteroid injection. The patient's main goals were to regain enough mobility in

her left shoulder to be able to perform activities of daily living (ADL) such as dressing and hair care without restrictions or pain.

Examination

Self-Report Outcome Measures

Two self-reported outcome measures were used in this case report: the Disabilities of the Arm, Shoulder and Hand (DASH) and the Shoulder Pain and Disability Index (SPADI). The patient's initial total DASH score was 65. This is a 30-item, self-administered, region-specific outcome instrument developed as a measure of self-rated upper extremity disability and symptoms. DASH has been found to be a reliable and valid measure of upper extremity disability¹⁷. The patient's initial total SPADI score was 72. This is a self-report, 13-item questionnaire found to be reliable and valid to measure the pain and disability associated with shoulder pathology¹⁸.

Physical Performance Measures

The patient was no longer taking anti-inflammatory medication when the intervention began. ROM examination of the left shoulder was performed with a standard goniometer and as described by Magee¹⁹. External rotation was measured with the arm by the side of the body in the adducted position (ER/ADD). Internal rotation was also measured by having the patient reach behind

her back and noting what vertebral level could be reached with the thumb²⁰. Table 1 reflects week-to-week progression in ROM. External rotation was described as very painful 10/10 on a verbal scale rating¹⁶ at 20° (passive) with abnormal capsular end-feel as described by Cyriax³. Resisted isometric muscle testing of the left shoulder as described by Magee¹⁹ was normal.

Of interest was the lack of shoulder adduction combined with extension, which was noticed when the patient attempted to reach behind her back. To quantify combined extension and adduction of the shoulder, an alternate approach was used. The adduction/extension component was broken down to compare its end-feel as described by Cyriax³ with the unaffected arm. A standard goniometer was used to quantify the amount of ROM into extension/adduction combined. With the patient standing with the unaffected arm against the wall to minimize compensation, the physical therapist applied an overpressure for end-feel assessment. Standing against the wall helps avoid the patient being pushed to the side when overpressure is applied for such assessment. It was also more comfortable for the patient to stand instead of lie down on the affected arm when assessing the uninjured arm. The fulcrum was aligned posterior to the acromial process, while the proximal arm was aligned perpendicular to the axis aligned with the T-3 spinous process, which is anatomically aligned with the spine of the scapula¹⁹, and towards the wall. The movable arm was aligned along the postero-lateral humerus with the forearm supinated to bring as much shoulder external rotation because the CHL is lax in internal rotation¹⁴. The scapula and proximal arm of the goniometer were stabilized by the examiner's proximal hand while the distal hand held the moving arm of the goniometer. The forearm was supinated and shoulder externally rotated. The shoulder was hyper-extended 10° and fully adducted with light overpressure applied until a firm end-feel was felt or when pain was first reported over the anterolateral shoulder. Careful attention was taken to avoid thoracic rotation and to maintain body, and more specifically,

neutral spinal alignment. The same measurement was taken on the unaffected arm. The patient's initial measurement was only 5° of combined extension/adduction on the affected (left) shoulder and 25° degrees on the unaffected right shoulder. Figure 1 depicts the shoulder adduction/extension measuring technique with overpressure being applied. This type of measurement technique has not been studied for validity or reliability. A presumptive argument to support the use of this technique was made based on the anatomical alignment of the fibers of the CHL and rotator interval capsule and on finding a positioning that would stretch such structures. Extension combined with adduction *may* provide a stretch to both bands of the CHL. The benchmark for comparison was the unaffected shoulder.

Clinical Impression

The evaluation of the patient's examination and systems review lead to a differential diagnosis of stage I (painful freezing stage) frozen shoulder. The generated working hypothesis driving the clinical decision-making process in determining a differential diagnosis was that restricted shoulder external rotation was due to capsuloligamentous restrictions of the CHL and rotator interval. The targeted intervention was aimed at providing a positional low load and prolonged stretch to the CHL and the area of the rotator interval capsule following anatomical fiber orientation. A favorable prognosis was anticipated from this intervention and was supported with the rationale of tissue remodeling through gentle and prolonged tensile stress on identified restricting tissues⁵.

Intervention

The intervention consisted of two main components: 8 supervised in-office therapy sessions and 17 episodes of a self-stretching home program over a 4-week period. The in-office supervised sessions consisted of an 8-minute active warm-up on an upper body ergometer (UBE) at 50 rpm for 8 minutes; initial goniometric measurements; one thera-

pist directed positional CHL stretching repetition along with a cold pack, building up from 5 minutes at the initial visit to 15 minutes toward the end of the second week (the patient continued stretching for 15 minutes on weeks 3 and 4); volitional rotator cuff exercises that included active ROM into the scapular plane⁶; forward shoulder flexion; and seated external rotation with the arm at 70° of abduction resting on a table. Final measurement of active and passive ROM was taken at the end of each session. Three sets of 10 repetitions of all volitional exercises were performed daily and through the patient's determined tolerable ROM. Exercises were performed just below pain threshold with the patient progressing from active isotonic to 2 pounds of resistance by the third visit. By the fourth visit, the patient was independent with the volitional rotator cuff exercises so it was left for home program only. ROM measurements were taken after active warm-up on the UBE. A home exercise program consisted of CHL stretching technique (described below) with cold pack over anterolateral shoulder with the goal of up to and no more than 20 minutes twice per day along with one pre-selected volitional exercise session with

FIGURE 1. Alternative goniometric measurement

the 2-pound weight, which was provided to the patient. The rationale for using cryotherapy along with the stretching is based on the concept that cold would actually contract the tissues in the new lengthened position²¹. The patient reported doing the routine twice a day for only a week, then only once a day for the remaining 3 weeks due to a lack of time. In addition, she missed 5 days due to family problems. The patient reported that she never held the positional stretch for more than 15 minutes at home. The dosage of CHL stretching was based on the principle of Total End-Range Time (TERT) or the total amount of time the joint is held at near an end-range position as described by McClure²². The *dose* formula is based on intensity, frequency, and duration of the tensile stress applied to the tissues that are restricting motion²². Intensity was limited to the patient's pain tolerance. McClure²² suggested an initial TERT of at least 20 minutes without increasing pain with the use of splinting leading up to one hour per day. Upon discharge, the patient was instructed to continue her home exercise program at least once per day for 4 more weeks and to stay aware of any signs of loss of mobility.

Description of Positional CHL Stretching Technique

The technique involved the patient side-lying on the unaffected (right) side. A pillow was placed under the patient's head to keep the head aligned with the body. The affected (left) arm was resting on the patient's side. The physical therapist instructed the patient to grab a 20–22 inch dowel with the affected (left) arm, always keeping the left forearm supinated in order to encourage shoulder external rotation. The physical therapist explained to the patient that forearm pronation would lead the shoulder into internal rotation and the CHL into a slack position, a loose, relaxed, and inefficient position for stretching the CHL¹⁴. With one end of the dowel on the table, the physical therapist instructed the patient to hyperextend the shoulder approximately 10° and then adduct the arm as close to her body as tolerated by sliding the left hand down the dowel.

The patient was instructed to concentrate on keeping the proximal humerus adducted and extended, and the forearm supinated and to avoid compensatory trunk rotation. Posterior trunk rotation was the most important to avoid as this may bypass stretching the shoulder altogether. The patient was told to expect a slight *stretching* sensation in the anterolateral aspect of the left shoulder and possibly in the region of the bicipital tendon further distally. Using the dowel served three purposes: 1) to gradually slide the hand down into extension and adduction, 2) to help keep the forearm supinated, and 3) to avoid fatigue of the arm just hanging behind the body, which initially led to compensatory trunk rotation when the dowel was not used. It is important to note that scapular retraction was unavoidable, even on the uninvolved arm; however, the amount of retraction was minimal. Figure 2 depicts the CHL positional stretching technique.

Outcomes

Ten weeks after the onset of symptoms and one month after the onset of physical therapy, the patient achieved gains in both DASH (36 down from 65) and SPADI (8 down from 72) scores. There was a 51° gain in passive external rotation, and a 60° gain in active shoulder abduction. On the activity and participation domain and domestic life subdomain of the International Classification of Functioning, Disability and Health (ICF), at discharge, the patient was able to take care of her hair, get dressed, and perform all house chores independently. However, the patient still reported a pain level of 3/10 on the numeric verbal pain scale¹⁶ when reaching up on her back with her left hand and a pain level of 2/10 when sleeping on her involved (left) side. Table 2 depicts DASH/SPADI and ROM gains.

Discussion

The purpose of this case report was to describe the use of positional stretching of the CHL on a patient with stage I frozen shoulder. The importance of this case lies in the development of treatment interventions, strategies, and tactics by physical therapists for quickly and effectively resolving stage I adhesive capsulitis. In this case, the patient demonstrated a 51° improvement in passive shoulder external rotation after 4 weeks of positional CHL stretching.

There is no description in the literature of an *exact duration time* of a TERT dosage. McClure et al²² describes remodeling of connective tissues as a biological phenomenon that occurs *over long periods of time* rather than a mechanically induced change that occurs within minutes. In a research report, Feland et al²³ classified a *long duration stretch* as a stretch greater than 30 seconds for one repetition. Research on the variables of intensity and duration for stretching connective tissues have produced three significant findings²⁴. First, short duration stretching of high intensity favors the elastic response, while prolonged duration stretching of low intensity favors the plastic response. Second, there is a direct correlation between the duration of a stretch and the resulting proportion of plastic, permanent elongation. Finally, there is a direct correlation between the intensity of a stretch and the degree of either trauma or weakening of the stretched tissues. McClure et al²² pointed out that the maximum TERT will be different for each patient and is often dictated by circumstances, such as a job or other responsibilities, which may prevent a patient from increasing TERT. In this case, the patient was able to perform CHL stretches at home only twice per day for the first two weeks, then only once per day due to her job schedule.

FIGURE 2. Positional coracohumeral ligament stretch

TABLE 2. Week-to-week progression in range of motion and outcome measures

ROM; Active/Passive (°)	Initial	Week 1	Week 2	Week 3	Week 4 Discharge
Flexion	130/135	140/144	150/154	155/159	155/159
Abduction	95/110	115/121	138/142	150/154	155/158
External rotation	15/20	33/35	37/41	55/58	65/71
Internal rotation	50/55	60/66	65/68	70/73	70/75
Reaching back to spine with thumb	4 inches superior to gluteal fold	Coccyx	L5 spinous process	L5 spinous process	L4 spinous process
Combined extension/ADD	5°	9°	12°	14°	16°
SPADI	72	N/T	N/T	N/T	8
DASH (total score)	65	N/T	N/T	N/T	36

° = degrees

In terms of retaining newly increased ROM post-intervention, changes in ROM due to viscoelastic phenomena can be easily demonstrated with procedures that are typically applied for brief periods such as joint mobilization and other passive techniques; therefore, tissues that have been temporarily *stretched out* eventually return to prestretch lengths²³. According to Davies and Ellen Becker²¹, this is one reason joint mobilizations by themselves are not effective in increasing ROM around joints with arthrofibrosis; and the sooner interventions are applied to the compromised tissues, the more likely the involved tissue will respond as collagen needs to be stretched along the lines of stress to produce collagen realignment. Desai¹⁵ reflected on his experience during a surgical procedure of a patient with frozen shoulder as follows: “The CHL felt like a thickened cord, which tightened further on attempted external rotation and as soon as the CHL was excised, the improvement in external rotation was obvious.”

Several limitations can be identified in this case report. Even though initial measurements of combined humeral extension and adduction were considerably different, there is a lack of standardization, validity, and reliability studies for this alternative measurement technique. The stretching technique used in this study is new and has not been validated in randomized trials. Patients and therapists must constantly

be aware of compensatory movements such as scapular retraction and trunk rotation that can easily disrupt the measurement and stretching techniques of the CHL. Tolerance was an important factor considered in the decision to keep the TERT goal for up to and no more than 20 minutes. Since the patient was side-lying holding the dowel, at times verbal cues were required and the patient became distracted and began to rotate the trunk, hence effectively reducing TERT. Another limitation is normal individual variations in body structure that may result in instances in which the end-feel differs from known end-feel descriptions. For example, the measurement of a person with a very muscular arm may be affected by soft tissue approximation more than someone with a thin arm. For this reason, measurements should be taken by the same therapist and compared only with the unaffected arm, unless it is also limited by some other type of pathology. Intratester reliability has been found to be higher than intertester reliability when the same examiner took successive measurements²⁵.

Further research is required to determine the validity of positional CHL stretching as an effective technique. This case report could not determine whether positional CHL stretch alone caused the documented gains in shoulder ROM. Such causality would have to be determined in a controlled randomized trial. In an attempt to reduce the influence of

co-interventions, the plan of care included only prolonged positional CHL stretching with ice and a simple volitional exercise program completed both during in-office supervised visits and via an unsupervised HEP. Future controlled studies should focus on the effectiveness of positional CHL stretching in patients in both the freezing and adhesive stages of frozen shoulder along with the most effective TERT for the CHL and rotator cuff interval. A patient in the adhesive stage is likely to have much more limited ROM than a patient in stage I as described by Dias². The influence of the corticosteroid injection that the patient received one week prior to initiating therapy was likely to be palliative as the patient continued losing ROM after receiving the injection. The injection likely helped control the inflammation from the mild synovitis detected in the MRI, hence helping reduce pain but not the fibroblast proliferation at both the rotator cuff interval and the CHL seen in the pathogenesis of frozen shoulder^{12,13}. The effects of corticosteroid injections may last several weeks²⁶ so it is very likely that the influence of the injection was positive in helping the patient tolerate the treatments with less pain.

Conclusion

Because the resolutions of impairments and functional limitations as well as the outcomes for this patient were favorable, the potential impact on clinical practice

may reach not only the level of treatment but prevention and screening as well. If randomized trials find this technique to be effective and valid, it could be used by physical therapists in their assessments and as a screening tool for cost-effective early intervention in patients with frozen shoulder. Physical therapists could justify this intervention for an anticipated problem, which, in this case could be the loss of function, related to frozen shoulder as it progresses. Implementing the predictive criteria would then be based on best available evidence.

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