

End-Range and Scapular Mobilization Technique Versus Passive Stretching Exercises in Treatment of Shoulder Adhesive Capsulitis

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Abstract

Background: Idiopathic adhesive capsulitis of the shoulder is a condition characterized by gradual loss of active and passive glenohumeral motion. The prevalence of adhesive capsulitis is estimated to be two to five percent of the general population. Stretching the adhered shoulder capsule by means of end range mobilization and passive stretching is the cornerstone of physical therapy interventions for treatment of adhesive capsulitis. Scapular mobilization is also recommended to correct the abnormal scapulohumeral rhythm accompanied with the limited motion at glenohumeral joint in patients with adhesive capsulitis.

Aim of Study: To compare between the effect of end range mobilization and scapular mobilization versus passive stretching exercises on shoulder pain severity, functional disability and passive range of motion of shoulder flexion, abduction, internal rotation and external rotation in treatment of idiopathic shoulder adhesive capsulitis.

Design of the Study: Randomized clinical trial, pretreatment posttreatment design was used.

Methods: Forty male patients with idiopathic adhesive capsulitis of the shoulder, whose age ranged between 40 to 65 years with limited shoulder passive range of motion in at least 2 of 4 directions and duration of illness ranged between 3 and 12 months participated in this study. They were randomly distributed into two equal experimental groups. The first group received end range mobilization technique and scapular mobilization technique and the second group received passive stretching exercises. In addition to that both groups received infrared radiation before each treatment session for warming up. All patients were treated twice weekly for six weeks.

Results: Both groups had significant improvement in all measured variables. End range mobilization and scapular mobilization was significantly more effective than passive stretching exercises in improving shoulder pain severity, functional disability and range of motion of shoulder flexion and abduction. However, there was no significant difference between groups in improving range of motion of shoulder external rotation and internal rotation.

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Key Words: Shoulder adhesive capsulitis – End-range mobilization – Scapular mobilization – Passive stretching exercises.

Introduction

PRIMARY adhesive capsulitis, or frozen shoulder, is a condition characterized by gradual loss of active and passive glenohumeral motion [1]. The prevalence of adhesive capsulitis is estimated to be two to five percent of the general population and is more prevalent in individuals who are 40 to 65 years of age, in females, and in individuals who had a previous episode of adhesive capsulitis in the contralateral arm [2]. Green et al. [3] reported that adhesive capsulitis is generally considered self-limiting having a natural history of 6 to 18 months with total remission typically occurring within 2 to 3 years, whereas others [4,5] reported long-term limitations without spontaneous recovery. There is slow onset of pain felt near the insertion of deltoid, inability to sleep on the affected side, painful and restricted elevation and external rotation, with a normal radiological appearance [6].

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 technique has been recommended for patients with adhesive capsulitis [7]. Endo et al. [8] reported that scapular motions towards depression, downward rotation, external rotation, and posterior tilt are severely restricted in frozen shoulder. Evidence from other studies [9,10] suggested the use of scapular mobilization for reduction of pain and improvement of glenohumeral range of motion in adhesive capsulitis.

Stretching exercises are commonly used in treatment of adhesive capsulitis patients either in the form of a supervised in-clinic exercise programs or as a home exercise program [11-15].

To our knowledge there are no previous studies compared between end-range and scapular mobilization technique versus passive stretching exercises in treatment of idiopathic adhesive capsulitis. Therefore this study was conducted to compare between these two commonly used interventions in treatment of idiopathic adhesive capsulitis.

Patients and Methods

This study was conducted in the outpatient clinic of physical therapy, health insurance hospital, The 10th of Ramadan City, Egypt between March 2017 and July 2019. Forty male patients with idiopathic adhesive capsulitis of the shoulder, whose age ranged between 40 to 65 years with limited shoulder passive range of motion in at least 2 of 4 directions (Limited shoulder passive range of motion was determined by inclinometer and defined as abduction $\leq 80^\circ$, flexion $\leq 130^\circ$, external rotation $\leq 30^\circ$, internal rotation $\leq 30^\circ$) and duration of illness ranged between 3 and 12 months participated in this study. Patients were excluded if the assessment showed radiographic pathological findings or glenohumeral osteoarthritis, clinical evidence of significant cervical spine diseases, history of significant trauma to the shoulder, local corticosteroid injection or any physiotherapy to the affected shoulder within the last three months, inflammatory joint diseases affecting the shoulder or diabetes mellitus. Patients were randomly distributed into two equal experimental groups. The first group consisted of 20 patients, their mean age was 52.80 (± 8.48) years, mean weight was 85.35 (± 8.88) Kg, mean height was 173.65 (± 4.99) cm and mean duration of illness was 5.35 (± 2.78) months. The second group consisted of 20 patients, their mean age was 48.40 (± 7.56) years, mean weight was 91.30 (± 16.67) Kg, mean height was 175.25 (± 5.62) cm and mean duration of illness was 5.35 (± 2.78) months.

Each patient was assessed pretreatment (2-3 days before the first treatment session) and post-treatment (2-3 days after the last treatment session) by measuring pain and functional disability using shoulder pain and disability index and passive range of motion of shoulder flexion, abduction, external and internal rotation using bubble inclinometer.

Shoulder pain and disability index (Appendix 1) is a valid and reliable index for measuring shoulder pain and disability [16]. It consists of two parts, part one which assesses pain severity and part two which assesses functional disability. Scores were calculated as following: in part one pain

scores of all questions were added and the final total pain score was used for the purpose of data analysis. In part two, disability scores of all questions were added and final total disability score was used for the purpose of data analysis. For measuring the passive shoulder motions the bubble inclinometer, which is valid and reliable, was used based on the work of Sharma et al. [17]. Each shoulder motion was measured three times and the mean of each one was used for the purpose of data analysis.

Patients in the first group received infrared radiation for 15 minutes for warming up, end range mobilization technique and scapular mobilization technique. The end-range mobilization technique started with warming up which consisted of 3 sets of 10 to 15 repetitions of rhythmic mid-range mobilizations with 10 seconds rest between sets. Thereafter, end range mobilization technique was applied as following: The arm was brought into a position of maximal flexion in the sagittal plane. Then three sets of 10 to 15 repetitions of grade 3 or 4 mobilization (according to the patient's tolerance) in this end-range position were applied with 10 seconds rest between sets.

Furthermore, the direction of mobilization was altered by varying the plane of elevation or the degree of rotation. In addition to varying the direction of mobilization, other movements such as gliding techniques consisting of caudal glide, posterior glide, and anterior glide were done to target the corresponding capsular restriction according to the convex-concave rule. Three sets of 10 to 15 repetition of each gliding mobilization were done with 10 seconds rest between sets.

This was followed by scapular mobilization technique which consisted of applying superior and inferior gliding, upward and downward rotation, and distraction to the scapula of the affected shoulder. Three sets of 10 to 15 repetitions of each mobilization based on the patient's tolerance were done with 10 seconds rest between sets.

Patients in the second group received infrared radiation for 15 minutes for warming up and passive stretching exercise program that consisted of passive shoulder stretching exercises in forward flexion, abduction, external rotation, internal rotation and horizontal adduction. Each passive stretching exercise was done 5 times with 15 seconds rest between repetitions. All patients were treated for 12 sessions, two sessions per week for 6 weeks.

Results

Pre-treatment comparison for the demographic data (age, weight, height and duration of illness) of both groups was done using unpaired *t*-test showed that there was no significant difference between groups ($p>0.5$). Pre-treatment comparison between groups for shoulder pain severity, functional disability and passive range of motion of shoulder flexion, abduction, external rotation and internal rotation was made by using unpaired *t*

test also showed that there was no significant difference between groups ($p>0.5$).

Post-treatment within groups difference: Using paired *t*-test showed that there was significant difference between the pre-treatment means and the post-treatment means of shoulder pain severity, functional disability and passive range of motion of shoulder flexion, abduction, external rotation and internal rotation in the both groups as shown in Tables (1,2).

Table (1): Within the first group (mobilization group) difference.

| Variables | Pre-treatment Mean (\pm SD) | Post-treatment Mean (\pm SD) | <i>t</i> -value | <i>p</i> -value |
|-----------------------|-----------------------------------|------------------------------------|-----------------|-----------------|
| Pain severity | 33.25 (\pm 7.48) | 9.4 (\pm 2.46) | 13.52 | 0.001 |
| Functional disability | 46.50 (\pm 14.50) | 11.70 (\pm 3.89) | 10.72 | 0.001 |
| Flexion | 97.00° (\pm 15.76°) | 154.75° (\pm 15.17°) | 14.94 | 0.001 |
| Abduction | 65.00° (\pm 16.46°) | 134.50° (\pm 24.92°) | 14.70 | 0.001 |
| External rotation | 25.00° (\pm 12.14°) | 49.50° (\pm 12.13°) | 13.53 | 0.001 |
| Internal rotation | 32.00° (\pm 12.71°) | 56.00° (\pm 12.83°) | 13.62 | 0.001 |

Table (2): Within the second group (stretching group) difference.

| Variables | Pre-treatment Mean (\pm SD) | Post-treatment Mean (\pm SD) | <i>t</i> -value | <i>p</i> -value |
|-----------------------|-----------------------------------|------------------------------------|-----------------|-----------------|
| Pain severity | 35.4 (\pm 4.98) | 22.9 (\pm 5.39) | 9.46 | 0.001 |
| Functional disability | 52.00 (\pm 10.56) | 33.40 (\pm 8.97) | 16.85 | 0.001 |
| Flexion | 96.00° (\pm 15.94°) | 135.75° (\pm 15.83°) | 13.75 | 0.001 |
| Abduction | 75.25° (\pm 15.43°) | 116.75° (\pm 17.69°) | 11.62 | 0.001 |
| External rotation | 28.25° (\pm 14.80°) | 46.00° (\pm 14.65°) | 9.33 | 0.001 |
| Internal rotation | 35.75° (\pm 15.58°) | 56.00° (\pm 15.69°) | 7.78 | 0.001 |

Post-treatment between groups difference: Using unpaired *t*-test showed that there was significant difference between the post-treatment means of shoulder pain severity, functional disability and passive range of motion of shoulder

flexion and abduction in favor of the first group (mobilization group). However there was no significant difference between the post-treatment means of internal rotation and external rotation as shown in Table (3).

Table (3): Post-treatment between groups difference.

| Variables | Mobilization group Mean (\pm SD) | Stretching group Mean (\pm SD) | <i>t</i> -value | <i>p</i> -value |
|-----------------------|--|--------------------------------------|-----------------|-----------------|
| Pain severity | 9.4 (\pm 2.46) | 22.9 (\pm 5.39) | 10.19 | 0.001 |
| Functional disability | 11.70 (\pm 3.89) | 33.40 (\pm 8.97) | 9.92 | 0.001 |
| Flexion | 154.75° (\pm 15.17°) | 135.75° (\pm 15.83°) | 3.88 | 0.001 |
| Abduction | 134.50° (\pm 24.92°) | 116.75° (\pm 17.69°) | 2.67 | 0.011 |
| External rotation | 49.50° (\pm 12.13°) | 46.00° (\pm 14.65°) | 0.82 | 0.416 |
| Internal rotation | 56.00° (\pm 12.83°) | 56.00° (\pm 15.69°) | 0.00 | 1.000 |

Discussion

The results showed that end range mobilization and scapular mobilization technique is significantly more effective than passive stretching exercises in improving shoulder pain severity, functional disability and range of motion of shoulder flexion and abduction. However, both treatments are equally effective in improving range of motion of shoulder external rotation and internal rotation in patients with idiopathic adhesive capsulitis of the shoulder.

Our findings are consistent with those reported by Shivakumar et al. [18], Kumar et al. [19]. Shivakumar et al. [18] reported that end range mobilization is significantly more effective than capsular stretching in reducing shoulder pain, improving function and increasing range of motion in patients with adhesive capsulitis. Kumar et al. [19] concluded that end range mobilization and scapular exercises combined with a conventional physiotherapy program are more effective than conventional physiotherapy alone in treatment of adhesive capsulitis. On the other hand, Ansari et al. [20] reported that a combination of end range mobilization and ultrasound is equally effective as a combination of passive stretching and cryotherapy in reducing shoulder pain and disability in patients with adhesive capsulitis without significant difference between both treatments.

Yang et al. [21] considered the improvement in shoulder mobility and functional ability shown in patients with adhesive capsulitis who were treated by mobilization techniques as a result of improving the normal extensibility of the shoulder capsule and stretching the tightened soft tissues. They also reported that these beneficial effects can only be achieved with end range mobilization techniques or mobilization with movement techniques rather than mid-range mobilization. Moore et al. [22] reported that at microscopic and macroscopic levels in the joint and in the surrounding tissue, mobilization could aid in the alignment of collagen, improving the balance of glycosaminoglycans and water content within the tissue, decreasing the formation of adhesions, improving tensile properties and encouraging collagen turnover. They also reported that these changes help to promote healing to ultimately increase range of motion and restore function.

The improvement in shoulder range of motion with passive stretching exercises can be attributed to elongation of the capsule and soft tissue surrounding the shoulder joint in the four directions in which stretching was applied. However improve

ment in shoulder flexion and abduction with end range mobilization and scapular mobilization was more significant. This could be a result of adding more stretch on the tightened capsule at end range positions as well as adding gliding mobilization which is known to improve physiologic accessory movements of the joints.

Paul et al. [23] reported that insufficient length of the anteroinferior capsule might be a critical mechanical factor for shoulder pain. In the present study targeting the adhered capsule with end range mobilization and gliding techniques produced more significant pain reduction compared to passive stretching exercises. Furthermore both groups showed significant improvement in functional ability. This is linked to the overall improvement in shoulder mobility and pain reduction. The improvement was more significant with end range mobilization and scapular mobilization compared to passive stretching. Using scapular mobilization may be a contributing factor to the more significant improvement in functional ability seen in our patients as performance of daily living activities requires the combined and coordinated motions of the scapulothoracic and glenohumeral joints.

Rundquist [24] reported that in patients with adhesive capsulitis, the scapula of the involved side was more upwardly rotated at peak scapular plane elevation than their uninvolved side when matched for humeral elevation angle. The upward rotation results support a theory of scapular compensation for loss of the glenohumeral range of motion to achieve greater humerus to trunk scapular plane elevation. Both treatment of glenohumeral range of motion deficits and the consequences of scapular substitution may be avenues for potential intervention.

The addition of scapular mobilization to end range mobilization was based on the conclusions of Yang et al. [21] and Vermulen et al. [25] who agreed that end range mobilization significantly improved shoulder range of motion but did not significantly improve abnormal scapular motion and scapulohumeral rhythm. Kershaw and Moran [26] reported that end range mobilization combined with scapular mobilization is more effective than end range mobilization alone in improving shoulder pain, function and mobility. Yang et al. [27] reported that end range mobilization and scapular mobilization are especially effective in adhesive capsulitis patients who had certain motion restriction criteria in shoulder kinematic analysis during arm elevation. Their findings showed that these techniques are

superior to passive stretching and mid-range mobilization in improving shoulder range motion and function and normalization of scapulohumeral rhythm.

We used high grade mobilization (grade 3 and grade 4) aiming at increasing soft tissue extensibility as our study included patients whose duration of illness ranged from 3-12 months (mainly second stage) when motion restriction takes place. Vermulen et al. [28] reported that high-grade mobilization techniques appear to be more effective in improving glenohumeral joint mobility and reducing disability than low grade mobilization techniques, with the overall difference between the two interventions being statistically insignificant. However Ali and Ali [29] reported that high grade mobilization techniques significantly improved the function of the shoulder than low grade mobilization techniques.

Joint mobilization techniques such as gliding are used to stretch the adhered capsule and improve the physiologic accessory movements. Gliding involves translational movement of one articular surface parallel to the other [4]. These techniques are considered capable of stretching the particular connective tissues that may limit joint motion, resulting in an improvement of the limited range of motion and reduction in pain [23]. Therefore we used gliding mobilization techniques in our study which consisted of caudal glide, posterior glide, and anterior glide to target the corresponding capsular restriction according to the convex-concave rule. The results reported by Johnson et al. [30] and Espinoza et al. [31] support our findings regarding the reduction of shoulder pain severity and improvement in range of motion of shoulder flexion, abduction and external rotation in patients who received these gliding mobilization techniques.

In our current study an infrared radiation was given at the beginning of each treatment session for both groups in order to allow the patients to tolerate a more aggressive stretching and mobili-

zation as recommended by the work of Manaska and Prohaska [32] but we could not directly measure this variable as its assessment requires shoulder motion analysis system that was not available in our study. Using such motion analysis system should be included in the assessment in future studies that include scapular mobilization.

Conclusion:

The purpose of this study was to compare between the effect of end range mobilization and scapular mobilization versus passive stretching exercises on shoulder pain severity, functional disability and passive range of motion of shoulder flexion, abduction, internal rotation and external rotation in treatment of idiopathic shoulder adhesive capsulitis.

Forty male patients with idiopathic adhesive capsulitis of the shoulder, whose age ranged between 40 to 65 years with limited shoulder passive range of motion in at least 2 of 4 directions and duration of illness ranged between 3 and 12 months participated in this study. They were randomly distributed into two equal experimental groups. The first group received infrared radiation, end range mobilization technique and scapular mobilization technique. The second group received infrared radiation and passive stretching exercises. All patients were treated twice weekly for six weeks.

The results showed significant improvement in both groups for all measured variables. End range mobilization and scapular mobilization was significantly more effective than passive stretching exercises in improving shoulder pain severity, functional disability and range of motion of shoulder flexion and abduction. However, both treatments are equally effective in improving range of motion of shoulder external rotation and internal rotation.

Conflict of interest: The authors declared that the present study was performed in absence of any conflict of interest.

Appendix (1)**Shoulder Pain and Disability Index:**

Please place a mark on the line that best represents your experience during the last week attributable to your shoulder problem.

Pain scale

How severe is your pain?

- Circle the number that best describes your pain where: 0 = No pain and 10 = The worst pain imaginable.

| | | | | | | | | | | | |
|-------------------------------------|---|---|---|---|---|---|---|---|---|---|----|
| At its worst? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| When lying on the involved side? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Reaching something on a high shelf? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Touching the back of your neck? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Pushing with the involved arm? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Total pain score _____ / 50 x 100 = _____ %

Disability scale

How much difficulty do you have?

- Circle the number that best describes your experience where: 0 = No difficulty and 10 = So difficulty it requires help.

| | | | | | | | | | | | |
|--|---|---|---|---|---|---|---|---|---|---|----|
| Washing your hair? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Washing your back? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Putting on an undershirt or jumper? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Putting on a shirt that buttons down the front? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Putting on your pants? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Placing an object on a high shelf? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Carrying a heavy object of 10 pounds (4.5 kilograms) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Removing something from your back pocket? | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Total disability score _____ / 80 x 100 = _____ %

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تقنية تليين نهاية المدى الحركى وتليين لوح الكتف مقابل تمرинات الإستطاله السلبية فى علاج الإلتهاب الإلتصاقى لمحفظة الكتف

الخلفية: الإلتهاب الإلتصاقى لمحفظة الكتف هو حالة مرضية تتميز بالفقد التدريجي لمدى الحركة الإيجابية والسلبية لمفصل الكتف. وقد تم تقدير انتشار هذه الحالة بنسبة ٥-٢٪ من التعداد العام. إطالة المحفظة الملتصقة عن طريق تقنية تليين نهاية المدى الحركى وتمريرات الإستطاله السلبية تعتبر حجر الأساس لبرامج العلاج الطبيعي لهذه الحالة. كما تعتبر تقنية تليين لوح الكتف من الطرق العلاجية الموصى بها أيضاً لتعديل مشكلة التزامن الحركى بين حركة عضدة اللوح وعزمة اللوح وعظمة العضد المصاحبة لنقص المدى الحركى لمفصل الكتف.

الهدف من البحث: المقارنة بين تأثير تقنية تليين نهاية المدى الحركى وتليين لوح الكتف مقابل تمريرات الإستطاله السلبية على شدة الألم والإعاقة الوظيفية ومدى الحركات السلبية فى الثنى والإبعاد والدوران الخارجى والداخلى لمفصل الكتف.

الطرق المستخدمة: شارك فى هذه الدراسة ٤٠ مريضاً من الذكور تراوحت أعمارهم بين ٤٠-٦٥ عاماً ولديهم قصور فى مدى الحركة السلبية لمفصل الكتف فى اتجاهين على الأقل من الإتجاهات الأربع المشار إليها سابقاً. علماً بأن الفترة الزمنية للمرض تراوحت من ٣ شهور إلى ١٢ شهراً من بداية الشكوى. تم تقسيم المرضى عشوائياً إلى مجموعتين متساوietين.

المجموعة الأولى تم علاجهم باستخدام تقنية تليين نهاية المدى الحركى وتليين لوح الكتف والمجموعة الثانية تم علاجهم باستخدام تمريرات الإستطاله السلبية. علماً بأنه قد تم استخدام الأشعة تحت الحمراء لجميع المرضى فى المجموعتين قبل بدء كل جلسة علاجية لغرض الإحماء. تم علاج جميع المرضى بمعدل جلستين أسبوعياً لمدة ٦ أسابيع.

النتائج: أظهرت المجموعتان تحسناً ملحوظاً في جميع المتغيرات التي تم قياسها. العلاج بتقنية تليين نهاية المدى الحركى وتليين لوح الكتف كان أكثر فاعلية بشكل ملحوظ من العلاج بتمريرات الإستطاله السلبية في تقليل شدة إلم الكتف وتقليل الإعاقة الوظيفية وتحسين مدى الحركة السلبية في اتجاه الثنى والإبعاد. إلا أنه لم يوجد فرق ملحوظ بين المجموعتين في تحسن مدى الحركات السلبية للدوران الخارجى والداخلى لمفصل الكتف.