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Original Research Article

EFFECT OF CERVICO-THORACIC MOBILIZATION ON HEMIPLEGIC SHOULDER PAIN WITH SUPRASPINATUS TENDONITIS DUE TO IMPINGEMENT SYNDROME: AN EXPERIMENTAL STUDY

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ABSTRACT

Introduction: Biomechanically cervical and thoracic spine is involved in impingement syndrome in hemiplegia. Aim of the study is to find the effect of cervico-thoracic mobilization on hemiplegic shoulder pain with supraspinatus tendonitis due to impingement syndrome.

Materials and Methods: The selected subjects were randomly assigned in to experimental and control groups with 15 subjects each. Experimental group received conventional exercises along with manual therapy i.e. Maitland's rhythmic oscillatory central PA mobilization of cervico-thoracic spine (C7-T4 vertebra) as tolerated by patient for a periods of 4 weeks. Control group received conventional exercises (stretching of internal rotators, supraspinatus muscle, weight bearing exercise, weight shifting exercises, strengthening, and scapular mobilization). Total duration of treatment was 5 days per week for 4 weeks.

Results: Result of the study suggested that both the control group and experimental group had a significant improvement in pain, ROM and disability in hemiplegic subjects with supraspinatus tendonitis causing impingement syndrome after treatment for 4 weeks. However, the experimental group showed greater change as compared to control group.

Conclusion: The study demonstrates that cervico–thoracic mobilization has better effect in improving pain, ROM and function compared to conventional treatment in hemiplegic subjects with supraspinatus tendonitis due to impingement syndrome.

KEY WORDS: Supraspinatus Tendonitis, Impingement Syndrome, Hemiplegic Shoulder Pain, Mobilization.

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INTRODUCTION

Shoulder pain is a common complication after stroke that can inhibit recovery and reduce quality of life. Incidence of hemiplegic shoulder pain (HSP) varies from 34 - 84%- [1]. Shoulder pain, by itself can result in significant disability (Najenson et al. 1971, Poduri 1993). Causes of hemiplegic shoulder pain are Capsulitis, Subluxation, Impingement syndrome (Rotator cuff injury, Bicipital tendinitis), CRPS – 1, Brachial plexopathy, Axillary neuropathy, Subscapular neuropathy, Myofascial pain, Spasticity, Soft tissue contracture [1]. Biomechanically possible causes of HSP due to impingement syndrome: 1. Inadequate external rotation of humerus due to hypertonicity and shortening of internal rotator during abduction lead to impingement of greater tuberosity against coracoacromial arch during passive movement and causes pain [2]. 2. Loss of scapulohumeral rhythm: During arm abduction scapula and humerus moves in a ratio of 1:2. Normally scapula moves in forward and upward direction during abduction. In hemiplegia delayed scapular rotation due to increase tone in muscles leading to retraction and depression. If the patient's scapula doesn't move sufficiently when his arm is being lifted passively trauma occurs and patient experience pain at shoulder [2]. 3. Lack of downward movement of head of humerus in glenoid fossa [2]. Because of these biomechanical changes, during passive/active abduction greater tuberosity impinges with acromion leading to Supraspinatus tendinitis, Subacromial bursitis, Rotator cuff tear [1].

Involvement of cervical and thoracic spine in impingement syndrome: Well in 1988 found that supraspinatus tendonitis and capsulitis have frequently their origin totally or part from cervical or upper most thoracic spine. Any lesion of nervous system can lead to increase tension within the system as a whole. Hemiplegic patient have abnormal tension of nervous system and loss of adaptive lengthening of neural structures. A sensitive cervical nerve root could possibly alter the mobility of glenohumeral joint and shoulder as a whole and mimic as a true glenohumeral condition. With stiff upper thoracic spine extension, the rib may subluxate superiorly on fixed thoracic spine and result in pain and dysfunction around shoulder [2]. Increased thoracic kyphosis tend to abduct the scapula and downwardly rotate it altering the scapulohumeral relationship which leads to muscle weakness and decreased ROM resulting in impingement syndrome [3].

Thoracic spine forms a key link in the kinematic sequence of arm elevation. Thoracic side bending and rotation are caused by unilateral humeral motions. The relationship between reduced mobility of the cervicothoracic spine and shoulder pain could be explained by this reflexogenic mechanism. Thoracic joint manipulation improves spinal mobility, and also assisted in decreasing distal and autonomic symptoms [4]. Painful hemiplegic shoulder can be very limiting and has the potential to further add to the disability seen with hemiplegia. The development of painful hemiplegic shoulder is associated with severe stroke and poor functional outcome [5]. Management of the painful hemiplegic shoulder, once the condition has developed, is difficult and response to treatment is frequently unsatisfactory. Current management for HSP are positioning of hemiplegic shoulder, slings and other aids, strapping the hemiplegic shoulder, active therapies, electrical stimulation, surgery, butulinium toxin injection, steroid injection, aromapathy and acupuncture, subscapular nerve block, segmental neuromyotherapy, relieving anxiety, general activities, increasing range of passive movement, self assisted arm activities, scapular mobilization [5]. As described, biomechanically cervical and thoracic spine is involved in impingement syndrome in hemiplegia. Thoracic kyphosis also found to be increased in hemiplegics which is associated with hemiplegic shoulder pain[3]. Cervical and thoracic central posterior to anterior mobilization increase the sympathetic activity of upper limb [6], reduce the stiffness of spine [7], reduce thoracic kyphosis [8] and improve posture [9,10] thereby reduce shoulder pain in hemiplegics. No study could found the effect of cervico-thoracic mobilization in HSP with supraspinatus tendonitis due to impingement syndrome.

Aim of the Study:

To find the effect of cervico-thoracic mobilization on hemiplegic shoulder pain with supraspinatus tendonitis due to impingement syndrome.

MATERIALS AND METHODS

Study design: Pre test and post test experimental study design. Subjects: A total of 30 subjects with hemiplegia due to stroke diagnosed clinically as supraspinatus impingement syndrome who met inclusion and exclusion criteria were recruited from the outpatient and in-patient department of SVNIRTAR and a written consent was obtained from each subject. Group Assignment: The selected subjects were randomly assigned to experimental and control group.

Inclusion criteria: Complain of shoulder pain, age- 25–65 years**,** tenderness over supraspinatus tendon, with positive Hawkins Kennedy impingement sign and Neer's impingement test.

Exclusion criteria: Complete rotator cuff rupture, Adhesive capsulitis, Bicipital tendinitis, Glenohumeral instability, Labral tears, OA around shoulder complex, Acute fracture, Cervical nerve root pathology, Tumor, active systemic disease, Spinal hypermobility, History of shoulder pain before stroke, Cardiac symptoms, Any other contraindication to manual therapy technique.

Independent variables: Maitland's rhythmic oscillatory central PA mobilization of cervico-thoracic spine ($C_7 - T_4$ vertebra) as tolerated by patient. Shoulder rehabilitation programme including stretching of internal rotator, supraspinatus muscle, weight bearing exercise, weight shifting exercises, strengthening, scapular mobilization.

Dependent variables: Shoulder pain and disability index (SPADI): The SPADI is a self administered questionnaire that consists of two dimensions, one for pain and other for functional activities. The pain dimension consists of five questions regarding the severity of individual's pain. Functional activities are assessed with 8 questions designed to measure the degree of difficulty an individual has with various activities of daily living that require upper extremity use. It was used to assess the pain and functional level of the subjects.

Visual analogue scale (VAS): Visual analogue scale was used to measure subjective pain intensity. This is a card with an uncalibrated scale ranging from 0-10 on one side (with '0' representing no pain and '10' representing worst pain in life) and corresponding 10 cm ruler on other side (with each cm representing pain level 1).

Pain free ROM: Standard universal goniometer was used to measure passive glenohumeral internal rotation, external rotation and shoulder complex abduction with elevation ROM.

Procedure: All subjects after meeting inclusion and exclusion criteria were asked to fill the consent form and then randomly divided into 2 groups. Experimental group -15 subjects, Control group - 15 subjects. Before initiating treatment, subjects were assessed for baseline values of all the dependent variables. Therapy was started the day after the measurement was taken. Experimental group received conventional exercises i.e. shoulder rehab programme along with manual therapy for a period of 4 weeks. Control group received conventional exercises for a period of 4 weeks.

Total duration of treatment was 5 days per week for 4 weeks.

Data Collection: Measurements were taken prior to the beginning of treatment (pretest) and were repeated after completion of four weeks (post-test).

Data Analysis: The dependent variables were analyzed using a 2×2 ANOVA, repeated measures on second factor. There was one between factor (group) with two levels (groups: experimental, control) and one within factor (time) with two levels (time: pre, post). Post-hoc analysis was done using a 0.05 level significance.

RESULTS

Fig. 1: Change in SPADI score.

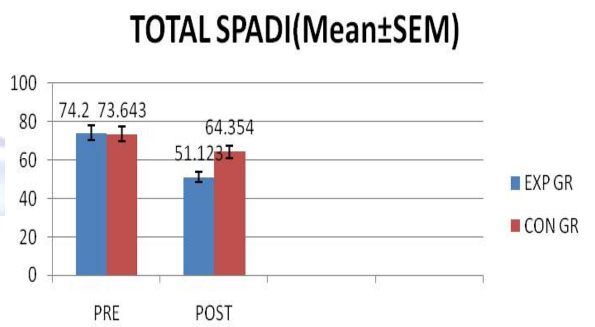

Figure 1 illustrates that there was improvement in TOTAL SPADI score in both the group following 4 weeks of intervention. However, experimental group showed better improvement in post measurement compared to control group.

There was a main effect of time F (1, 28, 0.05) = 383.870, p = 0.000. There was main effect for group also F (1, 28, 0.05) =5.740, p= 0.024. The main effect were qualified to Time × Group interaction also F (1, 28, 0.05) = 69.671, p = 0.000. Tukey's post hoc analysis shows statistical significant improvement in total SPADI scores in both the groups after 4 weeks of intervention. However, the improvement in experimental group is significantly more.

Fig. 2: Change in VAS score.

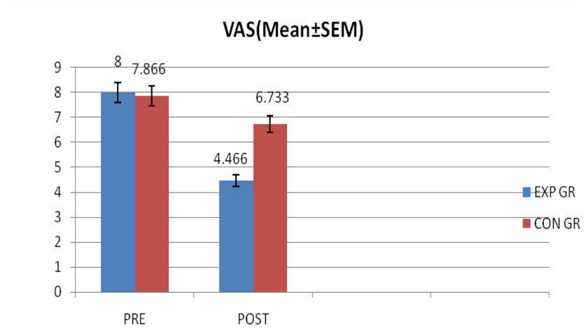

Figure 2 illustrates that there was improvement in VAS score in both the group following 4 weeks of intervention. However, experimental group showed greater improvement in post measurement compared to control group.

There was a main effect of time F (1, 28, 0.05) = 612.500, p = 0.000. There was main effect for group also F (1, 28, 0.05) =13.033, p= 0.001. The main effect were qualified to Time × Group interaction also F (1, 28, 0.05) = 162.000, p = 0.000. Tukey's post hoc analysis shows statistical significant improvement in VAS scores in both the groups after 4 weeks of intervention. However, the improvement in experimental group is significantly more.

Fig. 3: Change in EXTERNAL ROTATION range.

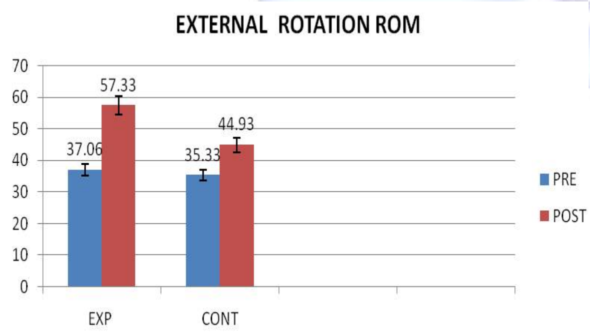

Figure 3 illustrates that there was improvement in pain free external rotation ROM score in both the group following 4 weeks of intervention. However, experimental group showed greater improvement in post measurement compared to control group.

There was a main effect of time F (1, 28, 0.05) = 3345.067, p = 0.000. There was main effect for group also F (1, 28, 0.05) = 749.067, p= 0.000. The main effect were qualified to Time × Group interaction also F (1, 28, 0.05) = 426.667, p = 0.000.Tukey's post hoc analysis statistical significant improvement in pain free external rotation ROM score in both the groups after 4 weeks of intervention. However, the improvement in experimental group is significantly more.

Fig. 4: Change in INTERNAL ROTATION range.

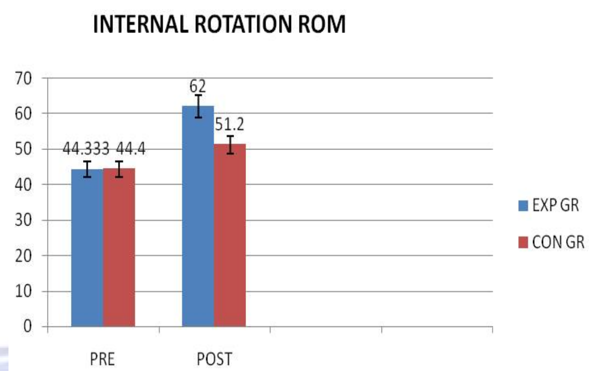

Figure 4 illustrates that there was improvement in PAIN FREE INTERNAL ROTATION ROM score in both the group following 4 weeks of intervention. However, experimental group showed greater improvement in post measurement compared to control group.

There was a main effect of time F (1,28,0.05) = 2244.817, p=0.000 . There was main effect for group also F (1, 28, 0.05) =13.028, p= 0.001. The main effect were qualified to Time × Group interaction also F (1, 28, 0.05) = 289.243, p = 0.000. Tukey's post hoc analysis shows statistical significant improvement in internal rotation ROM score in both the groups after 4 weeks of intervention. However, the improvem-ent in experimental group is significantly more.

Fig. 5: Change in ABDUCTION range.

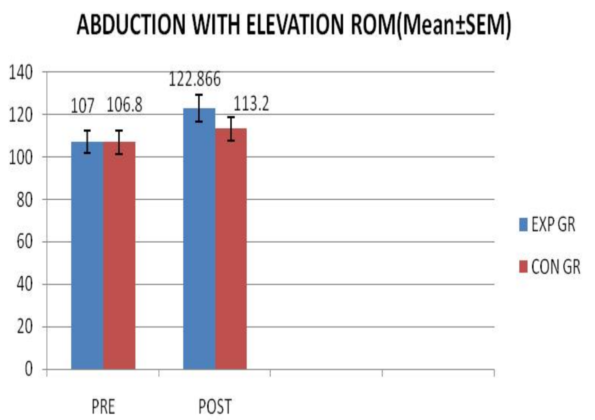

Figure 5 illustrates that there was improvement in ABDUCTION WITH ELEVATION ROM score in both the group following 4 weeks of intervention.

However, experimental group showed better improvement in post measurement compared to control group.

There was a main effect of time F (1, 28, 0.05) = 549.924, p = 0.000. There was main effect for group also F (1, 28, 0.05) =14.904, p= 0.001. The main effect were qualified to Time × Group interaction also F (1, 28, 0.05) = 99.400, p = 0.000. Tukey's post hoc analysis statistical significant improvement in SPADI DISABILITY score in both the groups after 4 weeks of intervention. However, the improvement in experimental group is significantly more.

DISCUSSION

The Overall result of the study suggested that both the control group (conventional therapy like scapula mobilization, strengthening, stretching of internal rotator and supraspinous, weight bearing exercises) and experimental group (conventional exercise along with cervico-thoracic mobilization) had a significant improvement in pain, ROM and disability in hemiplegic subjects with supraspinatus tendinitis causing impingement syndrome after treatment for 4 weeks. However, the experimental group showed greater change as compared to control group.

Pain: Abduction without scapular upward rotation leads to impingement [2]. Basmajain (1979, 1981) reported that restoration of scapular posture to normal result in restoration in passive but effective function of shoulder joint [11,12]. Mobilisation of scapula in to full elevation and protraction might have helped in restoration of scapular posture and pain free passive movement thereby decrease the impingement [2].

The shoulder fails to rotate externally because of the hypertonous and short internal rotator. Shoulder abduction without adequate external rotation causes impingement of soft tissue and gives rise to pain. Sustained stretch through positioning modifies or reduces the tone, improves the external rotation range thereby decreases the impingement and pain [13].

Subjects also received passive supraspinatus stretching in sitting with hand behind the back position. Heng Zhao et al (2008) [14] on ultrasonic evaluation had found change in biomechanical property, hysteresis, length of muscle following stroke. Stretching realign the scar tissue fibres so that they can heal correctly. This might have reduced the pain also.

Hemiplegic subjects demonstrate weakness of external rotator as part of their impairment. Imbalance between rotator cuff and deltoid is another cause of impingement. Resistance exercise helps in increasing strength and endurance in these subjects. In this study, only the shoulder external rotators were strengthened as internal rotators were found to be spastic. So active free and active assisted manual strengthening was encouraged in sitting position with the arm by the side (infraspinatus), arm abducted to 75° (teres minor) and abduction in scapular plane (supraspinatus). Leviseth G (1994) had found that in painful shoulder reduced muscle endurance and fatigue can lead to important changes in rotator cuff as well as in deltoid muscle [15]. Strengthening might have improved endurance and increase Na, K concentration; there by reduction of pain have achieved [15]. Strengthening is an important treatment which gives nutrition to the degenerated, inflamed tendon so also restructuring of the collagen tissue have achieved in the plane of stress.

Control group had also received weight bearing and weight shifting through the affected upper extremity. Sustained stretching through weight bearing also modifies or reduces tone [13]. In this study, the subjects were positioned in sitting position and arm is gently taken in to extension, slight abduction and externally rotated position. This position might have reduced the tone of internal rotator thereby improved the external rotation range. Weight shifting with maximum physical support, minimum resistance and minimum speed are the key to inhibit spasticity where the distal end of the extremity was kept in contact with the couch and the proximal end moved in small range [16].

Besides this conventional treatment experimental group had taken an additional cervico–thoracic central PA mobilization. Well in 1988 [17] found that supraspinatus tendonitis and capsulitis in hemiplegics have frequently their origin totally or part from cervical or upper most thoracic spine. The effect of cervico-thoracic mobilization can be attributed to their mechanical, neurological, reflexogenic and psychological effect. Increase thoracic kyphosis tends to abduct the scapula and downwardly rotate it altering the scapulohumeral relationship which leads to muscle weakness and reduced ROM [3]. As a result shoulder impingement may present. Adequate thoracic extension creates a more optimal rib cage surface to allow the scapula to move. Thoracic kyphosis and stiffness make the overhead motion difficult and lead to subacromial impingement [18]. Many a reasearcher found relationship between scapular position and shoulder dysfunction [19]. So position of scapula on thoracic spine has a greater influence on posture and shoulder pain. Some authors have also advocated that cervical and thoracic spine has a strong influence on the position and mobility of the scapula and glenohumeral joint [20,21]. Therefore, in this study Mobilization of the stiff thoracic spine might have reduced stiffness, altered the position of scapula, improved the posture and thereby reduce impingement and pain.

Wright A 1995, Vecenzino et al 1995 [22,23] had proposed that manual therapy relieves pain by modification of chemical environment of peripheral nociceptors, activation of segmental pain inhibitory mechanism, activation of descending pain control system. In a study, Sterling et al had found sympathetic activity of upper limb with Grade III PA mobilization to C5/C6 motion segment [24]. Sympathetic neurons in the upper limb arise from T2-T5 spinal segments (grey anatomy). Hence the corresponding spinous processes C7-T4 were mobilized [25].

Wainner et al (2001) [26] has proposed the mechanism that effect of thoracic manipulation in shoulder patients is based on regional interdependence. If one area such as thoracic spine is dysfunctional, that may also affect the mobility of shoulder and create shoulder pain. The reduction of pain following mobilization in experimental group might be due to placebo effect. Zusman 1986, 2004 and Katavich 1998 [27-29] had found the placebo effect of spinal manual therapy. Both the groups have taken conventional treatments which were supervised as well as hands on. But the experimental group had received an additional cervico-thoracic mobilization which was more hands on treatment and had a placebo effect from lying on of hands hence shown better result.

External Rotation ROM: Both the groups stretching of internal rotator and strengthening of external rotator was done that might have improved the external rotation range. But the experimental group was treated with additional cervicothoracic mobilizations that have increased more the external rotation range in this group. Joseph et al (2009) [30] in their study found 30° increase total rotation (external and internal) range of motion following thoracic manipulation in shoulder pain subjects. In this study, we found 39.3 degree improvement in combined external and internal rotation ROM. Another study by Creighton University (2012) [31] had found thoracic mobilization improves shoulder external rotation ROM in normal individuals. Furthermore, experimental group had shown better reduction of pain. As the pain subsided, these individuals might have done external rotator strengthening exercises adequately without fatigue and pain that might have an effect on external rotation range.

Abduction ROM: The limiting factors for the reduced abduction ROM are limited external rotation, inflamed, thickened, supraspinatus tendon and the fear of pain. It has already been discussed that strengthening improves the blood flow to the supraspinatus muscle and reduce the inflammation. In a review of articles Bovend'Eerdt et al in 2008 had found stretching in short term reduce the spasicity [32]. So here Sustained stretching of internal rotators might have reduces the spasticity of internal rotators and increase the external rotation ROM. Scapular mobilization also might have improved shoulder girdle mobility, so abduction ROM get increased. Abduction ROM increased parallel with the reduction in pain in both the groups. Therefore, both the control and experimental group had an improvement in abduction ROM.

Thoracic spine forms a key link in the kinematic sequence of arm elevation. Mcclure, 1999 [33] had found thoracic spine position significantly affect the scapular kinematics during scapular plane abduction. McClatchie et al (2008) [34] had found increase shoulder abduction painful arc following mobilization of the asymptomatic cervical spine. McCormack: 2012, Strunce: 2009 [35,36] had found improved active abduction ROM following thoracic mobilization in normal individuals with adhesive capsulitis and shoulder pain respectively. Another mechanism is that in both the group pain has reduced significantly but in the experimental group significantly more than control, that might have improved the shoulder abduction ROM.

Internal Rotation ROM: Warner JJ, 1990 [37] had found that patients with shoulder impingement syndrome often have limited internal rotation ROM. In both the groups, subjects were positioned in sitting with hand behind the back and are maintained passively by the therapist for 2 minutes. This position stretches the supraspinatus muscle. This may be one of the reasons why both the groups have improved internal rotation ROM. Another possible mechanism may be pain was the limiting factor for ROM restriction. In a study by Creighton University had found increased shoulder internal rotation ROM following thoracic manipulation. Pain referred from cervical region might be causing spasm around the shoulder musculature. Cervical mobilization reduce pain thereby spasm get subsided and internal rotation ROM had improved. Already it has been discussed that cervical and thoracic mobilisation has a hypoalgesic effect that might have improved the ROM.

Spadi Disability: There was statistical significant improvement in both the groups after 4 weeks of treatment. There was 24.97% improvement in experimental group and only 10.63% improvement in conventional group. Hemiplegics have weakness of muscles of upper limb as part of their impairment. In addition to it another factor that makes them disable is pain. Both the groups improved significantly but compared to control group experimental group have better improvement in pain that is being reflected in the disability score. As the pain reduced, they might have done strengthening exercises without pain and fatigue that had improved the strength which is also reflected by disability score. Bang and Deyle, 2000 [38] reported improvement in strength, function and pain when manual therapy to the shoulder, cervical spine and thoracic spine is added with exercise therapy in patients with shoulder impingement. Another possible mechanism may be the increased abduction, external and internal rotation ROMs have improved some function.

CONCLUSION

The study demonstrates that cervico-thoracic mobilization has better effect in improving pain, ROM and function compared to conventional treatment in hemiplegic subjects with supraspinatus tendonitis due to impingement syndrome.

Limitations: Smaller sample size, Strength of shoulder muscles has not been measured

Future Suggestion: Follow up is necessary to establish the efficacy of cervico-thoracic mobilization in management of supraspinatus tendonitis due to impingement syndrome in hemiplegics.

Conflicts of interest: None

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