ORIGINAL ARTICLE

THE IMMEDIATE EFFECTS OF ACROMIOCLAVICULAR JOINT MOBILIZATION ON SHOULDER RANGE OF MOTION: A QUASI-EXPERIMENTAL STUDY

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ABSTRACT

Introduction: The shoulder movement is dependent upon the integrated motion of many joints including Acromio-Clavicular Joint (ACJ). Chronic shoulder pathologies are likely to stiffen the ACJ and mobilization may reverse the effects. The current study aimed to study the effects of mobilization of ACJ on the shoulder ROM in healthy asymptomatic participants with restricted shoulder ROM.

Material & Methods: This single-subject quasi-experimental study recruited 30 healthy subjects with an equal proportion of males and females who had restrictions in the ROM. The mean age (SD) of the participant was 22.60 (±1.16 years), height 5.52 (±0.21) meter, weight 63.30 (±12.78) kg and Body Mass Index 22.22 (±3.84) kg/m2. Outcome measuring tools were shoulder range of motion (abduction, flexion, internal rotation, external rotation) and functional movements of reaching up behind the back and reaching down behind the neck. Acromioclavicular joint mobilization pre-intervention and post-intervention measurements of all variables were compared.

Results: The measurement of functional movements and all the ROM improved significantly from their baseline measurements following the ACJ mobilization. The mean change (±SD) in RBTB was 2.94 (±2.05), RBTN was 3.20 (±1.50), flexion was 6.53(±6.03), abduction was 8.83(±7.72), internal rotation was 7.60(±5.71), external rotation was 3.5(±5.80). The change was marked in RBTN (19.5%) and RBTB (17.9%).

Conclusion: ACJ mobilization acutely improves the shoulder range of motion in healthy subjects. ACJ is therefore recommended for trials on prevention and rehabilitation of the shoulder.

Key Words: prevention of shoulder injury, sports physiotherapy, shoulder injury, shoulder rehabilitation

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INTRODUCTION

The shoulder movement is dependent upon the integrated motion of the Acromioclavicular Joint (ACJ), sternoclavicular, scapulothoracic joint, and glenohumeral articulation.[1] Synchronized muscle action of the shoulder girdle is a prerequisite for smooth movement. The ligaments and the joint capsules afford the stability to the joints during motion.[2-4] Dysfunction in either of these elements leads to dysfunction of the shoulder joint. The dysfunction of these elements may be the result of a direct injury or a gradual change can occur

either due to excessive activity (overhead athletes) or no activity such as immobilization after wrist fractures.[1,5,6]

Glenohumeral Internal Rotation Deficit (GIRD) results from excessive external rotation of the shoulder in overhead athletes.[7] GIRD is reported to be associated with Posterior Capsular Tightness (PCT) which is a consequence of hypertrophy due to repetitive overload.[8] PCT is also related to scapular Dyskinesis but what comes first: the chicken or the egg?, is still under debate in the literature.[9-11] An imbalance in the force couple of trapezius and serratus anterior is frequently reported in association with scapular dyskinesis, subacromial impingement syndromes and internal impingements.[8]

GIRD and scapular dyskinesis are investigated prospectively in healthy asymptomatic subjects and a 43% risks of shoulder pain is estimated over the period of 9-24 months.[12-14] The Scapula is suspended from the clavicle by the ACJ and therefore requires anteroposterior and superior-inferior translation of the clavicle during the overhead elevation,[1,2,4] presumably in a way to neutralize the effect of gravity and maintain the line of gravity within the base.

Sufficient work has been done to study the various types of clavicle fractures and dislocation, but few reports exist on the ACJ kinematics. ACJ surgical fixation limits the glenohumeral range of motion.

Due consideration is not given to study the position and translation of the clavicle during functional movements of the hand behind the back and hand behind the neck during the chronic shoulder pathologies. Chronic shoulder pathologies are likely to stiffen the ACJ as well and mobilization will have a reverse effect. The current study aimed to study the effects of mobilization of ACJ on the shoulder ROM in healthy asymptomatic participants with restricted shoulder ROM.

MATERIAL AND METHODS

Study Design

To test the effect of the ACJ mobilization, pretest-posttest design was used. The experiment recruited 30 healthy subjects with asymptomatic shoulders who had restrictions in the range of motion. Grade 1 and grade 2 of the shoulder mobility test of the Functional Mobility Scale (FMS^R) was the primary inclusion criteria since the two extreme limits of reaching up behind the back and reaching down behind the neck are ascertained.[15] The restriction in these functional movements corresponds to the posterior capsular tightness, scapular dyskinesis and limitation in shoulder ROM. Healthy subjects with movement restriction were chosen to eliminate the restriction which can occur from muscle inhibition due to pain and strength deficits of muscle groups. The sample size was estimated from the trial of similar design with similar outcome measures.[16-20] Subjects with any pathology of the shoulder, grade zero and grade three on the FMS were excluded. Grade 3 represents no limitation and grade zero does not allow for the measurement since the subject cannot bring the arm behind the back. Ethical approval was taken from the HHIRS Research and Ethics committee and study design was approved by the BASR of Isra University, Islamabad campus. All the participants signed the approved consent form. The trial represents one of the arms registered on the clinicaltrial.gov (NCT04242888).

Participants

Forty-five males and 65 females were screened against the inclusion and exclusion criteria to recruit 30 subjects of equal proportion of male and female students. All subjects were undergraduate students of the Doctor of Physical Therapy program. Their mean ($\pm$SD) age was 22.60 ($\pm$1.16) years, height 1.68 ($\pm$0.06) meters, weight 63.30 ($\pm$12.78) kg and BMI was 22.22$\pm$3.84 kg/m^2. Most of the male subjects were involved in cricket and volleyball while most of the females were not participants in any athletic event, however, while doing house work, they would use their shoulders in overhead activities. The flow of participants shown in figure 1.

Data Collection and Instruments

For the FMS, hand length was measured from the distal wrist crease to the tip of the third digit. Grade 1 was one hand and one-half hand length while grade 2 was more than grade 1. These grades were used for inclusion and exclusion of the subjects only which detect limitation in the functional movement of Reaching up Behind The Back (RBTB) and Reaching down Behind The Neck (RBTN). The shoulder for intervention was considered from the dominant side and the other was left

untreated for a reference measurement during RBTB and RBTN.

To measure RBTB before the intervention, the subjects were asked to internally rotate, extend and adduct one arm and reach up behind, as much as he/she can, with the dominant hand and to exactly the opposite with the non-dominant hand for RBTN. Three measurements were taken on three times of repetition of the movement before and after the intervention. The distance between the close bony prominences on both the fists was measured. During the test, the hands remained in a fist in one smooth motion.[15,20]

A digital inclinometer was used for the collection of data on internal rotation, external rotation, flexion, and abduction of the shoulder joint. The Clinometer (inclinometer) was installed on a personal Samsung phone (note-8). Digital inclinometers have been shown to have a highly reliable method of measuring these ROM.[22-24] Internal rotation and external rotation were measures in supine lying position on a Bobath's plinth with the elbow flexed to 90 degrees and shoulder abducted to 90 degrees. Samsung note 8 was strapped to the wrist and reading set to zero at the begging of the active shoulder movement and reading was taken at the end of the range of active rotation. A total of four students including 2-males and 2-females were trained for collection of data and taking measurement for their respective genders. The consensus was reached by taking the mean of the two-reading taken by each student.

The use of digital inclinometer and functional movement screening for shoulder mobility has been used and reported in similar trials.[25,26]

Acromioclavicular Joint Mobilization

Before applying the manure, participant were asked to sit on the chair while the physiotherapist were standing behind the back of the chair where the patient was sitting on. ACJ was palpated by the physiotherapist who placed his/her thumb behind the posterior border of the clavicle for the treatment purposes. A gentle push was applied anteriorly through the thumb and posteriorly through the fingers. The physiotherapist used his/her the other hand to cuff the upper part of the deltoid for stabilization of the shoulder/scapula. During this treatment, a total of 5-10 oscillations per minute were applied at least 3 times. The applied force in the anterior and posterior direction was held for 10 seconds. The participant was asked to continue deep breathing during the whole session. The participants were guided to report any discomfort and in case any such discomfort was reported, the applied force was then adjusted accordingly.

For the treatment purpose, two of the physiotherapists were trained. The trained physiotherapists had at least three-years of experience in this specific mobilization. They had been applying these techniques and administered it to the participants of this trial.

Data Analyses

Descriptive statistics were calculated for all variables. Mean and standard deviation of the pre-test measurements, post-test measurements and the mean changes in between each of the dependent variables were computed using the paired t-test. Percentage changes from the baseline measurements were calculated to show the amount of improvement in addition to significant value. The effect size was calculated for each variable as the sample size appeared small. An independent t-test was used for comparison within the gender groups.

RESULTS

A total of 30 participant with equal percent of males and females were recruited for this trial. The mean age for male participant was 22.67 ±1.23 year and the mean age of the included females was 22.53 ± 1.12 years with a p-value of 0.76. This indicates that both of the included males and females were similar. The mean body mass index (BMI) of the included male participants was 23.23 ± 3.28 and the included female participants was 22.18 ± 3.22 kg/m2 with a p-value of 0.15.

Baseline statistics of shoulder ROM showed moderate limitations in mean values of flexion, abduction, internal rotation, and external rotation compared to the normative values in addition to the functional movement of RBTB and RBTN. Statistically significant change ($P<0.05$) occurred in all the ROM. Detail statics shown in table 1. Similarly, a greater effect size (< 0.80) calculated through Cohen's d equation was observed across all the variables except external rotation where the effect size was small due to the smaller mean change and larger standard deviation. RBTN, RBTB and internal

rotation showed a greater percent improvement of 19.40%, 17.90%, and 10.63% respectively.

DISCUSSION

The results of this study reveal that the ACJ mobilization effectively addresses the limitations in the functional movements of RBTB and RBTN. It is also helpful in increasing the limitations in internal rotation, flexion, and abduction. It is therefore recommended for inclusion in the set of manual therapies used for prevention and rehabilitation of the shoulder disorders associated with movement restrictions. A similar increase in ROM is reported by Rosa et al. through pectoralis minor muscles stretching protocol in healthy and subjects with shoulder symptoms in 6 weeks.[27] A sleeper's stretch applied to the posterior capsule in a similar way to the shoulder of asymptomatic intercollegiate athletes produced less pronounced outcomes. Other studies reported equivalent improvement in range of motion of shoulder after the application of 'cross-body stretch and sleeper's stretch' and 'sleeper's stretch alone' and modified stretch.[28-30] The duration of intervention, however, was 4 to 6 weeks rather than a single session as in the current study.

A more pronounced improvement in reaching up behind the back in the current study reveals that ACJ mobility is greatly required for the mobility of the scapula- an area that has been constantly ignored by the researchers. A stiffer ACJ may hinder the variety of movements that scapula exhibits during the movements of the arm. The movement of the scapula has been studied[1], however, ACJ and the clavicle did not get similar attention from the researchers except form a few reports.[2,3]

Internal rotation during the study was measured at a 90-degree abduction. At this range, the internal rotation requires the scapula to move and that's why improvement of 10.5% occurred after ACJ mobilization. Less pronounced improvement in flexion/abduction movement was noted, however, it may be clinically important. It has been observed by the principal author that the resolution of the symptoms of impingement, a pain in the last 20-30 degree of abduction or flexion is due to the lack of mobility of the ACJ and subsides when the ACJ is mobilized.

The male subjects in this study were recreationally active but not professional players where the GIRD and limitations in shoulder ROM was found due to the change in flexibility of the soft tissue under the influence of repeated overloads. Similarly, most of the female subjects were not playing any sport and would use their shoulder in house chores which might be considered as overhead activity but not as intense as in sports. These two factors might have affected the outcomes of this study. The sample size was appropriate and well balanced at the baseline with respective the characteristics of the subjects. There was slight variation in the BMI of both the genders which could affect the outcomes of the intervention. The subjects in the current study were healthy young individual and acute effects on shoulder ROM were measured. A repeated measure extended over longer duration will truly reflect the effects of the intervention. A digital inclinometer (clinometer) on Samsung note 8 is very sensitive to record minute changes and is a better alternative to the conventional and other inclinometers and goniometers as reported previously.[14] The study was conducted on healthy young subjects and it will be interesting to apply the ACJ mobilization on subjects with chronic shoulder pathologies with restriction in the ROM. The principal investigator further recommends a comparison of ACJ mobilization with the other form of manual therapies which claimed similar improvements in the range of motion.

CONCLUSION

ACJ mobilization improves the functional movement of reaching up behind the back and reaching down behind the neck in healthy young subjects. It is also helpful to improve the internal rotation at the 90-degree abduction of the arm. It is recommended for further trials on prevention and rehabilitation of shoulder pathologies with restricted ROM.

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Table 1: Range of Motion Before and After ACJ mobilization

Range of Motion	Pre-Intervention Mean (±SD) °	Post-Intervention Mean (±SD) °	Mean Change X(±SD) °	*Percent improvement*	P-Value	Cohen's d- values
Flexion	163.80(9.84)	170.33 (9.35)	6.53(6.03)	3.98%	≤0.05	1.08
Abduction	159.50 (14.60)	168.33(10.41)	8.83(7.22)	5.53%	≤0.05	1.22
Internal Rotation	71.47(11.96)	78.73 (10.620)	7.60 (5.71)	10.63%	≤0.05	1.26
External Rotation	79.07 (10.36)	82.60 (10.15)	3.50(5.80)	1.9%	0.03	0.60
Total Rotation	150.96 (12.60)	162.07 (10.98)	11.10(8.31)	4.40%	≤0.001	1.33
Reaching Up Hand Behind The Back (cm)	16.39(5.23)	13.46 (5.11)	2.94(2.05)	17.9%	≤0.001	1.43
Hand Behind The Neck	16.47(4.89	13.27 (4.64)	3.20(1.50)	19.4%	≤0.001	2.33

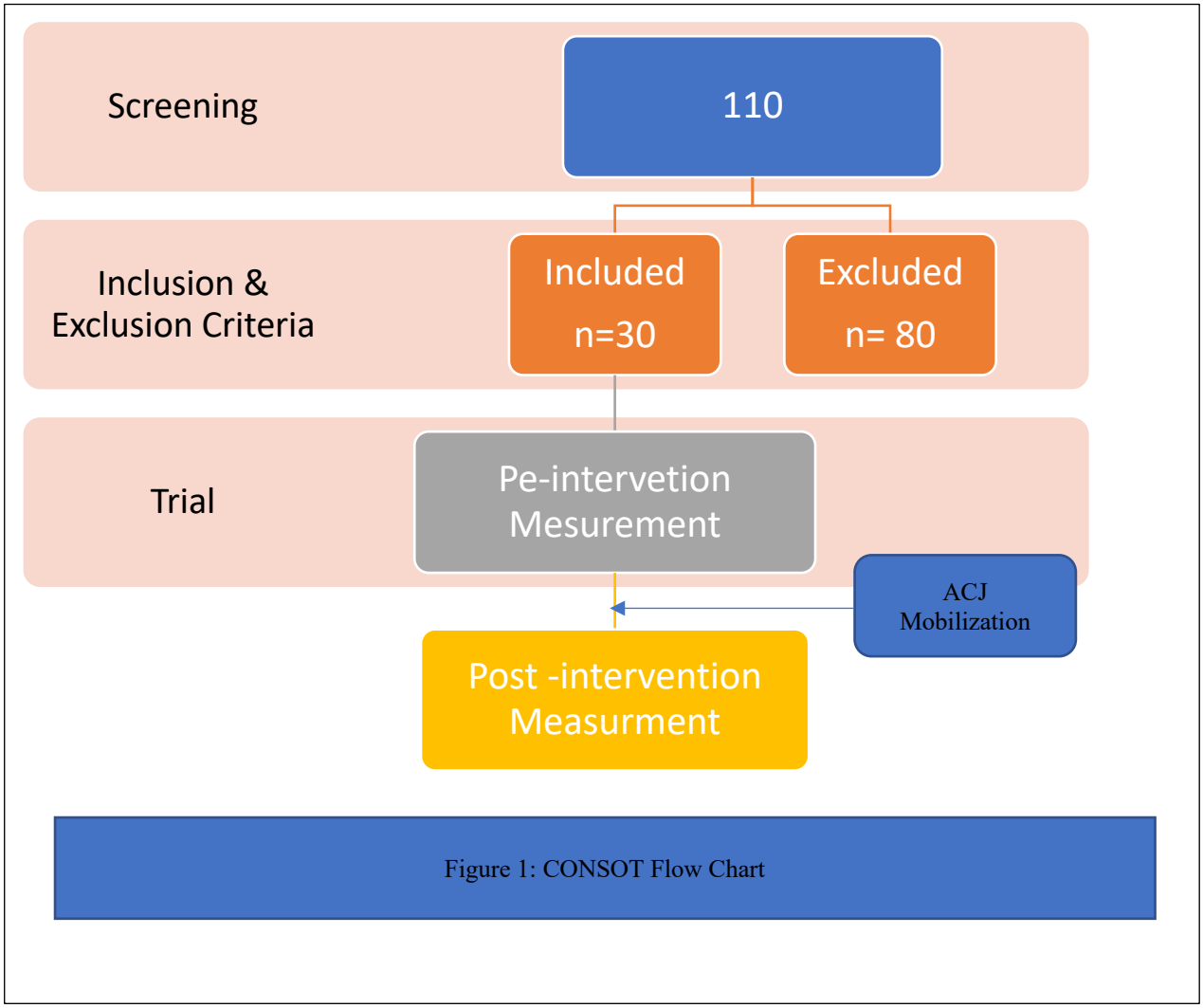

Figure 1: CONSOT Flow Chart