



EFFECT OF SCAPULAR MALPOSITIONING ON SHOULDER RANGE OF MOTION IN STROKE PATIENTS

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ABSTRACT

Purpose of the study: A healthy Shoulder has an extensive mobility in normal individual. The extensive range of motion of the healthy shoulder is a result of integrated movements of the sternoclavicular, acromioclavicular, glenohumeral and scapulothoracic joints. There is a coordinated actions of muscles (rotator cuff muscles, trapezius, rhomboids and serratus anterior) to bring about a normal range of motion of shoulder joint and scapula in normal healthy individuals Stroke causes severe dysfunction in the shoulder joint. There is also dyskinesia of scapulothoracic joint. However it is not known how these patterns of muscle activation change following stroke and how the scapular malpositioning affect shoulder range of motion. This study was conducted to find out whether only malpositioning of scapula can affect shoulder range of motion.

Methodology: Type of study : Observational-Analytical-Cross sectional study

- Scapular position of the affected side was assessed using acromial distance, modified Lateral Scapular Slide Test and visual observation
- Shoulder range of motion was assessed using goniometer
- Results were analysed using Pearson's Correlation coefficient test

Result: According to the study conducted, no significant correlation was found between scapular malpositioning and shoulder Range of Motion in stroke patients

Conclusion: The altered position of scapula does not affect the range of motion in stroke patients

Key Words: Scapular malpositioning, Shoulder ROM, Stroke

INTRODUCTION

Shoulder joint is a ball and socket type of joint with three degrees of freedom. The extensive range of motion of the healthy shoulder joint is a result of integrated movements of the sternoclavicular, acromioclavicular, glenohumeral and Scapulothoracic joints.

Scapulothoracic motion comprises of Sternoclavicular and Acromioclavicular motion. Scapulohumeral rhythm is an integral part of shoulder joint mobility. Normal Scapulothoracic motions those are necessary for arm elevation include upward rotation, posterior tilting, and either internal or external rotation.¹

Any alteration in the movement of scapula might lead to restricted range of motion at shoulder joint. Coordinated action

of muscles is required (rotator cuff muscles, trapezius, rhomboids and serratus anterior) to bring about a normal range of motion of shoulder joint and scapula in normal healthy individuals.¹

Stroke or cerebrovascular accident is a major cause of upper limb disability in population all over the world. Severity of the stroke varies depending upon the cause and location of the lesion. Immediately following Stroke, there is a stage of flaccidity where there is no voluntary motor control. The state of low tone may persist for weeks or months and is followed by stage of spasticity. Both these stages might lead to severe dysfunction in the shoulder joint. There is also dyskinesia of scapulothoracic joint. This may be due to various reasons like pain, subluxation, tightnesses and muscle weakness leading to altered position of scapula. Accurate tim-

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Received: 22.06.2016

Revised: 08.07.2016

Accepted: 20.07.2016

ing and scapulohumeral coupling is needed to preserve the suprahumeral space and prevent impingement of the rotator cuff tendons. Appropriate coupling includes upward rotation and posterior tilting of the scapula and external rotation of the humerus.^{2,3} Reduced voluntary neural drive due to the stroke may disrupt the timing and activation of Scapulothoracic and rotator cuff muscles.⁴

However it is not known how these patterns of muscle activation change following stroke and how the scapular malpositioning affect shoulder range of motion.

Ideal scapular resting position is defined in following way^[2]:

The superior angle of scapula and the lateral border of the acromion are located approximately on the same level as T2 and, thus, without excessive elevation or depression and 30 degree internally rotated with respect to the frontal plane. The orientation of the glenoid fossa should point downward (10 degree below to horizontal plane). In addition, the entire medial border of the scapula should be parallel to the thoracic midline; the scapula of the dominant side should be lower and farther away from the spine compared with the non dominant side; the medial border and inferior angle should be flat against the chest wall; the superior angle should be level with the spinous processes of T3 or T4; and the inferior angle should be level with T7, T8, T9, or even T10.

The changes in scapula of the stroke patients is that there is low tone that drifts into elevation and downward rotation with winging and or tipping (scapula gets tipped outward away from the thorax due to lack of scapular stability usually provided by the serratus anterior). This occurs primarily as a result of gravitational forces. Because of the trunk position (lumbar lordosis, thoracic kyphosis, and lateral flexion to involved side, slumped posture) this position of downward rotation and elevation is encouraged^[2].

1. Gravity pulls the scapula in downward rotation.
2. The patients' posture of forward trunk flexion reinforces scapular downward rotation and
4. promotes elevation of the scapula on the thorax.
5. Sternocleidomastoid becomes tightened leading to altered line of pull of the AC and SC joints.
6. Orientation of the glenoid fossa changes so that instead of facing upward, forward and outward it orients downward. This compromises the structural stability of the gleno-humeral joint.

Due to all theses impairments there is tipping and winging of scapula .This altered position of scapula might have an impact on glenohumeral range of motion.⁵

A study was conducted to find out the effect of shoulder girdle coordination on upper extremity workspace in stroke which concluded that under these conditions the scapula rotates laterally to allow the head of the humerus to clear the acromion.

However, if the scapular rotation is not sufficient, the head of the humerus will encounter a physical stop that prevents the arm from being elevated above a certain point^[6].A study was conducted to find out scapular and humeral movement patterns of people with stroke during range of motion exercises using kinematic techniques. The study concluded that people with hemiparesis had altered scapular and humeral movement patterns and increased shoulder pain when performing the range of motion exercises. This data can assist clinicians in making decisions regarding which exercise to prescribe to preserve shoulder motion and prevent contractures in this population^[7]. A study was conducted to find out how to assess scapular dyskinesia precisely:3-dimensional wing computer tomography a new diagnostic modality. The study concluded that the 3D wing CT analysis allows precise quantification of a position associated with scapular dyskinesia. Therefore,3D wing CT can be considered as an alternative method for assessing scapular dyskinesia^[8]. A study was conducted to determine whether scapular downward tilt and dynamic scapular lateral rotation in subjects with and without stroke was associated with subluxation. The study concluded that the subluxation was not linked with a particular resting position of scapula post stroke^[9].

A study was conducted to find out whether shoulder pain after stroke was related with subluxation, limitations in shoulder range of motions and upper extremity motor impairment. The results did not support a strong relationship between shoulder subluxation and pain after stroke. Appropriate precautions should be taken to prevent range of motion limitations that may result in shoulder pain^[10]. There are various tests used to determine if the scapula is positioned in an ideal manner or there is an altered position of scapula

Even though scapulothoracic joint has a lot of importance biomechanically it is not given so much of importance therapeutically. While considering the shoulder joint dysfunction the utmost importance is given to glenohumeral joint and hence the scapular malpositioning continues leading to dysfunction. Hence this study was conducted to find out the if scapular malpositioning in stroke patient leads to altered range of shoulder movement

METHODOLOGY

Materials:

- 1) Universal Goniometer
- 2) Metal tape
- 3) Paper
- 4) Pen
- 5) Pencil

Methods

• **Type of study:** Observational-Analytical-Cross sectional study

• **Sampling Technique:** Simple random technique

• **Sample size:**50

• **Inclusion criteria:**

- 1) All stroke patients of age 18 years and above.
- 2) Patient should be able to stand independently
- 3) Duration >1 month and < 2 years.

• **Exclusion criteria:**

1. Patients with any shoulder dysfunction prior to stroke.
2. Any shoulder injury post stroke
3. Subluxation of shoulder post stroke

• **Procedural tests:** Acromial distance test

Modified lateral scapular slide test

Observational Test: Visual observation test

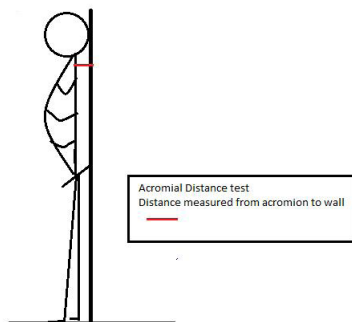
• **Ethics committee:** Ethics committee clearance was obtained from college ethics committee. Informed consent was taken from the patients fitting in inclusion criteria

1. Procedure:

• **To assess scapular positioning**

1) Acromial Distance (ADT)

The measurement of the distance between the posterior border of the acromion and the wall will be performed with the participant standing with his or her back facing the wall. First, the assessor will instruct the participant to put his or her feet and thorax against the wall and to stand relaxed. For both shoulders, the distance will be measured horizontally between the most posterior aspect of the posterior border of the acromion and the wall with the scale. The assessor will instruct the participant to actively move both shoulders towards the wall while keeping the thorax fixed against the wall and he or she measures the distance again.^{11,12}



2) Modified Lateral Scapular slide Test (MLSST)

Because the muscular system is the major contributor of scapular mobility and stability and because scapular positioning abnormalities can occur above 90° of humeral abduction Modified LSST test will include two static positions performed bilaterally: At 0°, 90° of humeral abduction in the frontal plane. The participant will be instructed to fix their eyes on an object in the examination area so they would maintain a fixed posture during the measurement. A metal tape will be used to measure the distance between the inferior angle of the scapula and the closest spinous process in same horizontal plane. Between positions, the participants will be instructed to keep their arm relaxed at the side^{11,13}

3)Visual Observation

The observation will be performed with the participant standing and relaxed. The scapula will be observed in resting posture, during active unloaded movement, and during active loaded movement. As muscle fatigue is an influencing factor during loaded movement, assessment reliability. The Participant was observed from dorsal (frontal plane) and lateral(sagittal plane) positions. During scapular observation at rest, all participants were observed bilaterally in three positions: resting with both arms relaxed (thumbs facing forward), hands placed on ipsilateral hips(thumbs facing backward), and arms in 90° of humeral abduction in the frontal plane.^{14,15}

ROM of shoulder was assessed using Universal goniometer.

Scapular positions assessed by Acromial Distance and Modified LSST were correlated with shoulder ROM were correlated using Pearson’s correlation

RESULTS

Table I: MLSST at 0° v/s shoulder Abduction ROM

V/S	Correlation coefficient	P value
MLSST at 0° v/s shoulder Abduction ROM	0.1569	0.3149(NS)

Table I shows that there is no significant correlation between the position of scapula at 0° and shoulder abduction.

Table II: MLSST at 0° v/s shoulder Flexion ROM

V/S	Correlation coefficient	P Value
MLSST at 0° v/s shoulder Flexion ROM	0.2233	0.155(NS)

Table II shows that there is no significant correlation between the position of scapula at 0° and shoulder flexion

Table III: MLSST at 0° v/s shoulder Extension ROM

V/S	Correlation coefficient	P value
MLSST at 0° v/s shoulder Extension ROM	0.09567	0.5417

Table III shows that there is no significant correlation between the position of scapula at 0° and shoulder extension.

Table IV: MLSST at 0° v/s shoulder Internal rotation ROM

V/S	Correlation coefficient	P value
MLSST at 0° v/s shoulder Internal rotation ROM	0.3291	0.0312

Table IV shows that there is no significant correlation between the position of scapula at 0° and shoulder internal rotations.

Table V: MLSST at 0° v/s shoulder External rotation ROM

V/S	Correlation coefficient	P value
MLSST at 0° v/s shoulder External Rotation ROM	-0.07105	0.6508

Table V shows that there is no significant correlation between the position of scapula at 0° and shoulder external rotation

Table VI: MLSST at 90° v/s shoulder Abduction ROM

V/S	Correlation coefficient	P value
MLSST at 90° v/s shoulder Abduction ROM	0.1222	0.4349

Table VI shows that there is no significant correlation is between the position of scapula at 90° and shoulder abduction

Table VII: MLSST at 90° v/s shoulder Flexion ROM

V/S	Correlation coefficient	P value
MLSST at 90° v/s shoulder Flexion ROM	0.2367	0.1265

Table VII shows that there is no significant correlation between the position of scapula at 90° and shoulder flexion

Table VIII: MLSST at 90° v/s shoulder Extension ROM

V/S	Correlation coefficient	P value
MLSST at 90° v/s shoulder Extension ROM	-0.03785	0.8096

Table VIII shows that there is no significant correlation is between the position of scapula 90° and shoulder extension

Table IX: MLSST at 90° v/s shoulder Internal Rotation ROM

V/S	Correlation coefficient	P value
MLSST at 90° v/s shoulder Internal rotation ROM	0.1422	0.3630

Table IX shows that there is no significant correlation between the position of scapula at 90° and shoulder Internal rotation.

Table X: MLSST at 90° v/s shoulder External Rotation ROM

V/S	Correlation coefficient	P value
MLSST at 90° v/s shoulder External Rotation ROM	-0.05385	0.7316

Table X shows that there is no significant correlation between the position of scapula at 90° and shoulder Internal rotation.

Table XI: ADT v/s shoulder Abduction ROM

V/S	Correlation coefficient	P value
ADT v/s shoulder Abduction ROM	0.1797	0.2490

Table XI shows that there is no significant correlation between Acromial distance test and shoulder abduction

Table XII: ADT v/s shoulder Flexion ROM

V/S	Correlation coefficient	P value
ADT v/s shoulder Flexion ROM	0.2330	0.1326

Table XIII: ADT v/s shoulder Extension ROM

V/S	Correlation coefficient	P value
ADT v/s shoulder extension ROM	0.2421	0.1178

Table XIII shows that there is no significant correlation between acromial distance test and shoulder Extension

Table XIV: ADT v/s shoulder Internal rotation ROM

V/S	Correlation coefficient	P value
ADT v/s shoulder Internal Rotation ROM	0.1536	0.3256

Table XIV shows that there is no significant correlation between acromial distance test and Shoulder internal rotation.

Table XV: ADT v/s shoulder External Rotation

V/S	Correlation coefficient	P value
ADT v/s shoulder External Rotation	0.1474	0.3455

Table XV shows that there is no significant correlation between acromial distance test and shoulder external rotation

DISCUSSION

In this study it was found that there is no effect of scapular malpositioning on the shoulder ROM.

There may not be any effect of scapular malpositioning on shoulder range of motion in stroke patients because in this study the tests which were used to measure scapular malpositioning mainly assessed scapular retraction. It is not always necessary that only scapular retraction has an effect on shoulder range of motion but there can be few other causes for affection of shoulder range of motion which can be Muscle imbalance, subluxation, shoulder pain, capsular tightness etc.

In normal individuals voluntary movement patterns utilize functionally linked muscles or synergies that are constrained by the CNS to act cooperatively to produce an action.. This movement may be disturbed in Stroke patients. Thus, the patient is unable to perform an isolated movement.

In scapula there is a force coupling between serratus anterior, trapezius and rhomboids which gets disturbed post stroke hence there is over activation of rhomboids¹ This disturbance is seen when the movement is bought about actively but in this study passive range of motion was measured and correlated with position of scapula hence there may not have been significant correlation between both.

Shoulder subluxation occurs in hemiplegia when any of the biomechanical factors contributing to glenohumeral stability are disturbed. When subluxation occurs, the movement possibilities are limited owing to the mechanical position of the

humeral head. Any movement that occurs will not follow the rules of scapulohumeral rhythm hence having an effect on shoulder range of motion.

As subluxation occurs, the shoulder capsule is vulnerable to stretch, especially when the humerus is hanging by the side of the body. In this position, the superior portion of the capsule is taut. The weight of the dependent humerus will place an immediate stretch on the taut capsule. Over time, the superior portion of the capsule will become permanently lax hence again having an effect on shoulder range on motion. One of the study conducted also conclude that subluxation and scapular malpositioning are not interrelated. The scapula normally tilts downward with or without stroke. The effect of stroke is similar on tonic (ScDT) and phasic (ScLR) control of scapula position. Subluxation is not linked with a particular scapular resting position after stroke¹⁶.

Thus Scapular malpositioning doesn't have an impact on shoulder ROM.

In this study, only passive ROM was considered hence similar study can be replicated with active ROM and on a larger sample size.

CONCLUSION

From this study it was found that there is no significant effect of scapular malpositioning on passive range of motion at shoulder joint in stroke patients.

ACKNOWLEDGEMENT

I would like to express my gratitude to the Principal and the staff of D.E.Society's Brijlal

Jindal College of Physiotherapy, Pune for their constant support and encouragement and for letting me use the college OPD and the college equipments. I am also thankful to the subjects of this study for their valuable participation. The authors of this study also acknowledge the great help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors/ editors/ publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

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