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An Effect of Scapular Position on Upper Limb Mobility among Stroke Patients in Tertiary Care Hospital: A Cross Sectional Study

Dr. Harsha Zadafiya[1], Dr. Dhwanit Shah[2]

[1]M. P. T. Neuro, Government Physiotherapy College, Surat, India
Corresponding Author's E-mail: *drharshaphysio2020[at]gmail.com*

[2]Ph.D, M. P. T. in Neuro, Government Physiotherapy College, Surat, India

Abstract: ***Introduction: Stroke is a major cause of upper limb disability in population all over the world. A paretic arm can change scapular orientation, as scapular stabilizers are often impaired by muscle weakness. Material and Method: A correlation study was conducted at new civil hospital where scapular position and scapular mobility were assessed in 72 subjects both males and females. Motor Assessment scale was used to measure Upper Limb Mobility and lennie's test and protractor method were used for scapular position assessment. Result: There were significant changes in vertical distance from T8, the superior angle, root of spine and inferior angle from spinal midline on affected dominant side as well as non-dominant side. Significant correlation of MAS with inferior angle and vertical measurement found. Correction of superior angle and root of spine of scapula with MAS were non-significant. Conclusion: There is Effect of Scapular Position on Upper Limb Mobility among Stroke Patients.***

Keywords: Stroke, Scapular Position, Upper Limb Mobility, Lennie test, UL Motor Assessment Scale

1. Introduction

Stroke is an acute cerebrovascular disease caused by hemorrhage or infarction induced cerebral blood supply interruption.[1] Stroke causes a sudden loss of neurological function caused by an interruption of the blood flow to the brain. [2]The pathophysiological basis of stroke can be defined as damage to motor cells and pathways of the Central Nervous System (CNS) due to hemorrhage or thrombus affecting the arterial supply of the brain, typically occurring with the little or no warning. [3]

Many patients are left with a disability of the upper limb which affects global movements (e.g. reaching) and hand dexterity. Negative symptoms (weakness and loss of individual joint control) are accompanied by positive symptoms with abnormal muscle contractions: spasticity (a velocity-dependent increase in stretch reflex) and abnormal synergies.[4]
Accurate timing and scapulohumeral coupling are 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.[5]

A paretic arm can change scapular orientation, as scapular stabilizers are often impaired by muscle weakness. The ability to maintain scapular position and control movement is essential for optimal upper limb function.The scapula provides dynamic stability with controlled mobility at the glenohumeral joint. It plays a significant role in facilitating shoulder joint function, as anatomy and biomechanics of the scapula allow for controlled movement of shoulder joints.[6]

During the flaccid stage, the trunk tends to lean or shorten toward the hemiplegic side, which causes the scapula to descend from its normal horizontal level. The trapezius and the serratus anterior also become flaccid, causing the scapula to rotate downwardly.[7]

Reduced voluntary neural drive due to the stroke may disrupt the timing and activation of Scapulothoracic and rotator cuff muscles. 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 due to gravitational forces.[5]

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During the spastic stage, the pectoralis major and minor, rhomboideus, elevator scapulae and latissimus dorsi can become hypertonic, further rotating the scapula downward, causing glenohumeral subluxation and shoulder pain.[7]

Apart from decreased glenohumeral motion, spasticity, subluxation and somatosensory impairments, poor scapulothoracic position and aberrant scapulohumeral motion are also considered risk factors in development of shoulder dysfunction and pain after stroke.[8]

People with more severe paresis and hypertonicity have less ability to fractionate movement and people with more mild paresis and minimal hypertonicity can make well-fractionated movements.[9]

Aims and Objectives
To study the effect of change in Scapular Position on Mobility of Upper Limb in Stroke Patients.

2. Methodology

Study Design: Cross sectional study

Study Population: Subjects with Stroke of minimum 3 months of duration

Study Setting: Physiotherapy Out-Patient Department, New Civil Hospital, Surat.

Sample Size: Sample size was calculated from Open Epi software, version 3 at 95% confidence level on basis of prevalence 4.87 and found 72 sample size.

Sampling Technique: Purposive Sampling

Inclusion Criteria:
- Stroke ≥ 3 months of duration
- Patient can stand independently
- Mini Mental Status Examination Scale >24
- Modified Ashworth Scale of upper limb muscle not more than 1+
- Both male and female subjects
- Subjects who diagnosed stroke
- Body Mass Index (BMI) < 30

Exclusion Criteria:
- Shoulder subluxation
- Any other neurological condition
- Recent trauma to upper limb which restrict upper limb movement or trauma to lower limb which can lead to difficulty in standing
- Participant not willing to participate in study
- Language problem and Cognitive disorders

Outcome Measure
- UL Motor assessment scale

3. Procedure

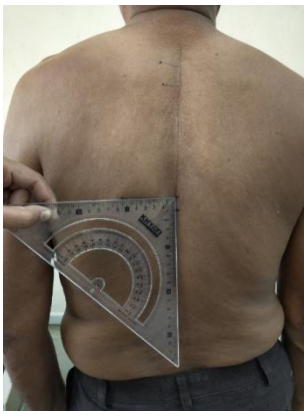
3.1 Lennie Test

Subjects were instructed to "stand facing straight ahead in the area of the floor marked by the square. Allow your hands, shoulders, arms and lower extremities to assume the positions they would normally assume while you stand in a relaxed fashion."
- The skin marking was done, using a fine-point blue pen. Markings were made on the skin overlying the affected scapula for the following landmarks: the Superior angle (the medial aspect of the most superior point), Root of the spine of the scapula (the medial aspect of the most medial point) and Inferior angle (the medial aspect of the most inferior point).
- All measurements were made from the center of the markings made with the pen. Three measurements of scapular position in the frontal plane were obtained for affected scapula. These measurements consisted of the following: Midline-to Superior-angle distance (defined as the distance from thoracic midline to the superior angle of the scapula), Midline-to-root distance (defined as the distance from thoracic midline to Root of the spine of the scapula) and Midline to Inferior-angle distance (defined as the distance from thoracic midline to the inferior angle of the scapula).[12]

3.2 Protractor Method

- An important aspect of measuring scapular position is to measure the vertical distance between a scapular landmark and a spinal landmark. This measurement would potentially provide a repeatable and valid measure of position, as the position of the opposite scapula may vary, but a vertebral body such as T8 would remain relatively unchanged.
- The Protractor method could be a useful tool in measuring elevation and depression of the scapula, both clinically and in future research.
- Participants were seated on an adjustable stool, in normal relaxed sitting, with their arms by their side and thumbs facing forward while looking forward at a mark on the wall fixed at eye level.
- A right-angle Protractor with the 18-cm side length and a scale that began from the edge of the Protractor was used. A Protractor that has at least 16-cm side length was required, as previous data indicated that the inferior angle of the scapula is, on average, 10.1 cm (range 6.7–15.3 cm) laterally from the spine.

A vertical distance was identified between landmarks using the Protractor. For T8 method, the Protractor was placed horizontally, aligning between the inferior angle of the scapula and the spine. The vertical distance was read from T8 to the line of Protractor that joining the mid scapular line to inferior angle of scapula. The tester recorded this measurement 3 times.[13]



Ethical Consideration
Ethical clearance is given by human research ethical committee, Government Medical College, Surat.

Stastical Analysis
The data availed were tabulated using MS excel. The demographic data and sex of the subjects in both groups were tabulated to know about the distribution of sample. Later, test for significance was done. The data was analyzed using SPSS software version 20. Collected data was analyzed using Kolmogorov-Smirnov test for normality before applying any statistical test. According to that data was not following normal distribution so nonparametric tests, Spearman rank correlation coefficient and Mann Whitney U test.

4. Results

Mean and Standard Deviation of Age and Duration

	N	MEAN ± SD
Age (Years)	72	51.82 ±15.76
Duration(Months)	72	17.54 ±23.08

Correlation of Motor Assessment Scale with Vertical distance, Superior angle, Root of spine of scapula, Inferior angle.

	R	P
vertical (cm)	0.379(**)	0.001
Superior angle (cm)	-0.002	0.988
Root of spine of scapula(cm)	-0.133	0.266
Inferior angle (cm)	0.335(**)	0.004

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

5. Discussion

There were 4 subjects with left affected as well as dominant side, 32 subjects with right affected as well as dominant side, 6 subjects having dominant left side with affected right side and 30 subjects having dominant right with affected left side. There was no significant difference found between dominant and non-dominant affected sides which was achieved by using Mann-Whitney U test.

Studies that shows the effect of dominant and non-dominant side shows contradicting results. Harris and Eng (2006) found that individuals with chronic stroke with dominant affected hand demonstrated less impairment than non-dominant hand affected. Jenne lagan et al. found that in their study that there are no significant changes seen between dominant and non-dominant affected side in constrained induced therapy.

Significant result found in correlation of MAS with inferior angle and vertical measurement with their p-values 0.004 and 0.001 respectively. Correction of superior angle and root of spine of scapula with MAS was nonsignificant. Since correlation of MAS with vertical distance and inferior angle were significantly correlated with Upper Limb Mobility.

Snehal Joshi et al suggest that there is no significant effect of scapular mal positioning on passive range of motion at shoulder joint in stroke patients. Liesbet et al said that scapula serves as a stable base for arm anteflexion. Motor control of shoulder relies on synchronized activation of upper trapezius and serratus anterior to rotate scapula upward. In stroke there is less activation of serratus anterior.

Ajit Dabholkar et al said that during the flaccid stage, the trunk tends to lean or shorten toward the hemiplegic side, which causes scapula to descend from its normal horizontal level. The trapezius and serratus anterior also become flaccid, causing the scapula to rotate downwardly. During the spastic stage, the pectoralis major and minor, rhomboids, elevator scapulae, and latissimus dorsi can become hypertonic, further rotating scapula downward.

The significance of difference in all measurements (vertical measurement, superior angle, root of spine of scapula, inferior angle) between 3 to 6 months and > 6 months of duration of stroke. The above result is achieved by Maan-Whitney U test and found that there is no significant difference between 3 to 6 months and >6 months in any of above measurements i.e. in subacute and chronic patients.

From all above measurement and values, we can say that after stroke of > 3 months of duration there are difference in scapular position than normal individual i.e. scapular dyskinesis. This Scapular dyskinesis can affect the Upper Limb Mobility.

So, from this data we can implicate the scapular muscle strengthening exercise in treatment protocol of stroke patients. It will help in increasing mobility of upper limb.

6. Limitation of Study

- Purposive sampling was used.
- Brunnstrom recovery stage was not taken into consideration.
- Strength of scapular muscles was not considered in this study.

7. Future Scope of the Study

- Inclinometer and Scapular jig are the instruments for measuring scapular malalignment. Study using these devices will give the perfect idea about Scapular Position and one can get the rotation of the scapula after stroke.
- One can also use Electromagnetic tracking device for assessment of scapular and humeral motion analysis.
- Study should conduct to focus Effect of Scapular strengthening on Upper Limb Mobility on different stages of stroke.

8. Conclusion

The result of the study satisfies the alternate hypothesis, there is Effect of Scapular Position on Upper Limb Mobility among Stroke Patients. As this malposition leads to affection on Upper Limb Mobility, this leads to further reduction in Upper Limb Mobility in cerebrovascular accident.

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