

THE RELATIONSHIP BETWEEN SCAPULAR POSITION ON UPPER LIMB FUNCTION AND TRUNK CONTROL IN POST STROKE PATIENTS

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ABSTRACT

Background: A cerebrovascular accident (stroke) is the loss of blood supply to the brain, leading to the development of various neurological impairments depending upon the area of lesion. The stroke can be either due to hemorrhagic or ischemic or hypoperfusion. Cerebrovascular accidents are the second most common condition resulting in the death of a person, and if a person survives the stroke, the person is most commonly left with impairments higher mental, sensory, motor function, balance and gait. The malalignment of the scapula can be found in both the flaccid stage and the spasticity stage. In the flaccid stage, there will be muscle weakness leading to the malalignment of the scapula. In the spasticity stage, the shortening of the soft tissues can result in scapular malalignment. Due to malalignment of the scapula, the movement of the scapula in the thoracic cavity is affected, and the scapulohumeral rhythm is also affected, leading to reduced upper limb function. The muscle imbalance surrounding the scapula causes scapular malalignment that can contribute to trunk instability. Normal scapular position and mechanics are essential for normal trunk balance and upper limb movements.

Objectives: Primary Objective- To find out the relationship between scapular position on upper limb function and trunk control in post stroke patients.

Secondary Objectives- To find out the relationship between scapular position and upper limb function in post stroke patients. To find out relation between scapular position and trunk control in post stroke patients.

Study Settings : Department of Neurology and Department of Physical Medicine and Rehabilitation, PSG Hospitals,Coimbatore

Methods : 46 stroke patients were screened and based on the inclusion and exclusion criteria, 30 patients who met the inclusion criteria and gave the informed consent to participate in this study were recruited. The patients were assessed for scapular position, trunk control and upper limb function using SBA, TIS and MESUPES- Arm .The collected data were analyzed using chi square test.

Results: Chi square test analysis was conducted to find out the relationship between scapular position, upper limb function and trunk control, it shows an association between SBA and MESUPES – Arm ($\chi^2 = 6.266$, $p<0.05$), SBA and TIS ($\chi^2 = 13.274$, $p<0.001$) which is statistically significant. It is found that in post stroke patients there is a relationship between scapular position, upper limb function and trunk control.

Conclusion: This study was conducted to determine the relationship between scapular position on upper limb function and trunk control in post stroke patients quantitatively assessed using scapular balance angle(SBA), motor evaluation scale for upper extremity in stroke patients (MESUPES –arm) and trunk impairment scale (TIS). Based on the results of this study, it is concluded that scapular position shows an association to upper limb function and trunk control in post-stroke patients, which indicates that when there is a scapular malalignment there is poor limb function and trunk control.

Keywords: Stroke Rehabilitation, Scapular Malalignment , Upper Limb Function, Trunk Control

INTRODUCTION:

Cerebrovascular accident (stroke) is the lack of blood supply to the brain leading to development of various neurological impairments depending upon the area of lesion. The stroke can be either due to haemorrhagic, ischemic or hypoperfusion. Cerebrovascular accident is the second most common condition resulting in the death of a person, and if a person survives the stroke, the person is most commonly left with impairments to the higher mental, sensory, motor function, balance and gait. Stroke is the acquired cause of hemiplegia or hemiparesis, where the motor, sensory and sensorimotor function of one half of the body is impaired.

Stroke patients may have cognitive dysfunctions, sensory impairment, muscle weakness, decreased muscle tone, and decreased voluntary motor control that can result in further complications and other impairments leading to disturbance in normal day-to-day activities, and the patient becomes dependent on others to carry out most of their activities of daily living. To restore the functions of the body, the patient is in need of a multidisciplinary rehabilitation approach. Physiotherapy plays a major role where a tailor-made rehabilitation protocol is designed by the therapist by assessing the patient. The main goal of physiotherapy rehabilitation is to improve the quality of life of the patient by making the patient as independent as possible.

The majority of the daily activities depend upon the use of the upper limb and trunk balance for various ADLs like eating, brushing, grooming, and dressing, and trunk balance is necessary to maintain the stability while doing these necessary activities. Lower limb function is necessary for weight bearing activities like standing and walking. When the function of the upper limb, lower limb, and trunk are affected, the patient has difficulty to perform the activities of daily living independently. They are dependent on others for these activities. Which can cause a decline in the psychological interaction with the family and environment

The scapula is the flat bone present in the upper back that has its connection to the neck, thorax and upper limb; they are connected to the scapula through muscles and ligaments originating and inserting throughout the scapula, it is connected to neck by muscles such as the trapezius, levator scapulae, and connected to the thorax by the scapulothoracic joint, The scapulothoracic joint is a physiological joint; it depends on the muscles and ligaments for its integrity. The scapula is connected to the upper limb by ligaments and muscles forming the shoulder joint.

The scapula is connected to corresponding structures mainly through muscles and ligaments When the motor function is impaired in these muscles, it leads to the malalignment of the scapula causing reduced function in the neck, upper limb and trunk.

The malalignment of the scapula can be found in both the flaccid stage and the spasticity stage. In the flaccid stage, there will be muscle weakness leading to the malalignment of the scapula. In the spasticity stage, the shortening of the soft tissues can result in the scapular malalignment. Due to malalignment of the scapula, the movement of the scapula in the thoracic cavity is affected, and thus affecting the scapulohumeral rhythm, leading to reduced upper limb function. The scapular malalignment will contribute to the trunk instability and can cause cervical dysfunction due to muscular imbalance. Normal scapular position and mechanics are essential for normal cervical mobility, upper limb function and trunk control.

There are studies which supports that including scapular exercises improve the trunk balance, and upper limb function, but there are no quantitative studies to prove that these components scapular position, trunk control and upper limb function are related to one another.

In my study I measured the scapular alignment, trunk control, and upper limb function to establish the relationship between these. The measuring tools used are SBA, there are various tools to measure the position

of the scapula, I used this because it measures the position of the scapula passively using the goniometer. TIS measures trunk balance and MESUPES- Arm scale used to measure the function of the shoulder. By using these three scales of measurement I am going to establish the relationship between the scapular position on upper limb function and trunk control.

MATERIALS AND METHODOLOGY

STUDY DESIGN: Correlational study design

STUDY SETTING: Department of Neurology and Department of Physical Medicine and Rehabilitation, PSG Hospitals, Coimbatore.

POPULATION/PARTICIPANTS: Patients who had stroke between the age 30-60 years with scapular balance angle greater than 7° from PSG Hospitals were taken as population for this study. A total number of 46 post stroke patients were screened and 30 patients from appropriate age groups with scapular balance angle greater than 7° were selected.

SAMPLING: Convenience Sampling

CRITERIA FOR SAMPLE COLLECTION:

INCLUSION CRITERIA:

- Age group (30 – 60 years)[2]
- Participants with first onset of stroke[2]
- Scapular balance angle > 7° [13]
- Subjects who give consent and willing to participate only in this study[1]

EXCLUSION CRITERIA:

- Participants with bilateral stroke[2]
- Participants with known history of spinal deformities and chest wall deformities[6]
- Participants with known history of shoulder subluxation, clavicular fracture[5]
- Other neurological conditions that affect upper limb function trunk control and scapular position[2][10]
- Participants who are uncooperative[1]
- Patients with musculoskeletal and Cardiorespiratory conditions[6][10]

STUDY DURATION: Total duration of 9 months was adapted for this study

INSTRUMENTS & TOOL USED FOR DATA COLLECTION:

1. Scapular Balance Angle (SBA)[13]
2. Motor Evaluation Scale for Upper Extremity in Stroke patients (MESUPES- Arm)[10]
3. Trunk Impairment Scale (TIS)[12]

STUDY PROCEDURE

The study was proposed in the Institutional Review Board (IRB). Permission from the heads of Department of Neurology and Department of Physical Medicine and Rehabilitation were obtained.

The study was submitted for ethical clearance in IHEC, PSG IMS&R Hospitals. The clearance was received, 46 stroke patients were screened and based on the inclusion and exclusion criteria, 30 patients who met the inclusion criteria and gave the informed consent to participate in this study were recruited.

The patients were assessed for scapular position, trunk control and upper limb function using SBA, TIS and MESUPES- Arm . The collected data were analyzed using chi square test.

STATISTICAL ANALYSIS

Descriptive analysis was used to find out the mean, standard deviation of age, SBA , MESUPES – Arm and TIS in post stroke patients. Data collected from subjects were analyzed using chi square test (χ^2) to find the relationship between scapular position, upper limb function and trunk control in post stroke patients which is measured by SBA, MESUPES –Arm and TIS using IBM SPSS

TABLE 1 : DEMOGRAPHIC DATA OF POST STROKE PATIENTS

VARIABLES	n= 30		
		n	%
GENDER	MALE	17	56.6
	FEMALE	13	43.3
TYPE OF STROKE	ISCHEMIC	24	80
	HAEMORRHAGIC	6	20
DURATION OF STROKE	ACUTE	13	56.6
	SUBACUTE	17	43.3
	CHRONIC	0	0
AFFECTED HEMISPHERE	RIGHT	10	33.3
	LEFT	20	66.6

Table- 1: Represents the demographic characteristics of patient's gender, type of stroke, affected hemisphere of post-stroke patients. Variables are given as frequency (n) and percentage (%)

VARIABLES	n	MEAN	STANDARD DEVIATION
AGE	30	51.63	7.33
SCAPULAR BALANCE ANGLE (SBA)	30	8.56	0.50
MOTOR EVALUATION SCALE FOR UPPER EXTREMITY IN STROKE PATIENTS MESUPES-ARM	30	3.46	4.03
TRUNK IMPAIRMENT SCALE (TIS)	30	2.46	0.50

TABLE 2 : DESCRIPTIVE ANALYSIS

Table – 2: Represents the continuous variables of age, SBA, MESUPES-Arm and TIS scores and variables are presented as mean and standard deviation.

TABLE 3
CHI SQUARE TEST BETWEEN SCAPULAR BALANCE ANGLE (SBA), MOTOR EVALUATION SCALE FOR UPPER EXTREMITY (MESUPES-ARM) AND TRUNK IMPAIRMENT SCALE (TIS) IN POST STROKE PATIENTS

VARIABLES	χ^2	df	p- VALUE
SBA AND MESUPES-ARM	6.266	1	0.012
SBA AND TIS	13.274	1	<0.001

Table 3: Represents the association between SBA, MESUPES-ARM and TIS

RESULTS:

Chi square test analysis was conducted to find out the relationship between scapular position, upper limb function and trunk control, it shows an association between SBA and MESUPES – Arm ($\chi^2 = 6.266$, $p<0.05$), SBA and TIS ($\chi^2 = 13.274$, $p<0.001$) which is statistically significant. It is found that in post stroke patients there is a relationship between scapular position, upper limb function and trunk control.

DISCUSSION

The aim of this study was to establish the relationship between scapular position, upper limb and trunk control in post-stroke patients. Scapular position, motor function of the upper limb, and trunk control were numerically assessed using the SBA, the Motor Evaluation Scale for Upper Extremity in Stroke Patients (MESUPES-Arm), and Trunk Impairment Scale (TIS). This study assessed these three components simultaneously within the same group of patients, to verify how scapular malalignment is associated with upper limb function and trunk control in post stroke Patients .

After analyzing the data, it was observed that there is an association between scapular position, upper limb function and trunk control in post stroke patients. It concludes that when there is scapular malalignment there is poor trunk control and upper limb function. The findings of this study are supported by research findings from Shaik SB et al.,(2023)[3], who demonstrated that incorporating scapular PNF techniques in post stroke patients led to improvement in the upper limb function. Their work highlight the role of scapular stability and mobility in restoring functional capacity of the paretic limb. This result also supports this study along with the study findings of Zadafiya H et al., (2020)[2] which reported that upper limb function is influenced by the alignment and stability of the scapula. Their study concluded that malalignment of the scapula influences the upper limb function, leading to functional limitations in post stroke patients.

In this study an association was found between the SBA, MESUPES- ARM and TIS, concluding that patients with scapular malalignment has a poor trunk control. This is supported by the study done by Oz R et al. (2023)[1] which highlighted the positive effects of scapular-focused exercises on trunk control, further

validating the present findings. This is also supported by Dell'Uomo D et al.,(2017) where they gave scapulohumeral exercises and improved trunk control in stroke patients.

More often the scapula is often considered during later stages of stroke rehabilitation—typically when shoulder subluxation occurs or when the shoulder fails to have its full recovery or when functional improvement reaches a plateau. The finding from the above mentioned literatures and the findings of this study together suggest that scapula should be assessed for its ideal position, alignment and scapular intervention. This study suggests that scapular alignment plays a crucial role from the early stages of recovery of stroke. The assessment and intervention will facilitate better upper limb function and trunk control in post stroke patients.

In clinical settings, the assessment of the stroke patients must include scapular assessment as part of standard post-stroke evaluations. Rehabilitation protocols

Should incorporate scapular positioning and scapular stabilization exercises from the beginning of physiotherapy treatment rather than delaying these interventions. Early attention to the scapula may enhance the effectiveness of conventional upper limb and trunk rehabilitation strategies.

Future studies are warranted to further explore the impact of early scapular management on functional outcomes. It will help to determine whether early scapular interventions lead to improvements in upper limb function, trunk control, and overall quality of life. Moreover, comparative studies investigating the relative effectiveness of various scapular interventions could help identify the most beneficial approaches for post-stroke patients. In conclusion, this study establishes that scapular malalignment affects both upper limb function and trunk control in post-stroke patients. It highlights the importance of including scapular assessment and intervention into early phase of rehabilitation.

LIMITATION AND SUGGESTION

LIMITATIONS

Calculated sample size could not be achieved as the patients did not meet the inclusion criteria and the flow of the patients were less than expected.

SUGGESTIONS

- The aim of this study was to determine the relationship of scapular position on upper limb function and trunk control in post stroke patients and the relationship was determined. In future larger number of samples can be taken to improve the statistical power.
- In further research, groups can be divided such as young adults, middle aged adults and elderly post stroke patients and how the scapular position is affected according to the age can be determined.
- Groups can be divided according to the duration of stroke and how the scapular position is affected in each stage can be determined.
- We can observe the longitudinal changes of the scapula occurring throughout the recovery of the stroke patients.
- In this study static stability of the scapula was determined in future dynamic stability of the scapula can be measured using appropriate tools.
- To advance the study of the mechanics of the scapular kinematics 3D motion analysis and EMG studies can be done.
- In further studies we can compare between two groups in which one group has scapular assessment and intervention from the beginning of their rehabilitation and another the scapular intervention is given at the later stage of their rehabilitation.
- Various scapular intervention can be applied at various stages of stroke and we can determine which is suitable to the patients in a particular stage.
- We can determine if the scapular alignment is the predictor of upper limb function and trunk control in post stroke patients.

CONCLUSION

This study was conducted to find out the relationship between scapular position on upper limb function and trunk control in post stroke patients quantitatively assessed using scapular balance angle(SBA), motor evaluation scale for upper extremity in stroke patients (MESUPES –arm) and trunk impairment scale (TIS). Based on the results of this study, it is concluded that scapular position shows a relationship to upper limb function and trunk control in post-stroke patients, which indicates that when there is a scapular malalignment there is poor upper limb function and trunk control.

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