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Relationship between Wrist Flexor Spasticity and Hand Function in Patients with Stroke

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ABSTRACT

Introduction: Stroke is one of the commonest causes of mortality and disability. Upper extremity affection in terms of functional activities is one of the common problems faced by patients with stroke. Very few studies have examined the relationship between upper extremity muscle spasticity and functional performance. This study aimed to determine the relationship between upper extremity spasticity and function.
Aim: To find out the relationship between wrist and elbow flexor spasticity and hand function in stroke patients
Setting and design: A cross- sectional study was conducted in 30 individuals with stroke in Physiotherapy OPD of D.V.V.P.F.'s College of Physiotherapy, Ahmednagar, India.
Materials and methods: Spasticity was measured by Modified Tardieu Scale which is a reliable and valid tool for assessment of stroke. Hand function was assessed by Action Research Arm Test.
Statistical Analysis: Pearson's correlation co-efficient was used to find the relation between wrist and elbow flexor and hand function.
Results: ARAT total scores and quality of muscle reaction and R2-R1 angle components of MTS of wrist flexor spasticity shows weak correlation r=0.1957 and r=-0.2241 respectively. ARAT total scores and quality of muscle reaction and R2-R1 angle components of MTS of elbow flexor spasticity shows weak correlation r= -0.2775 and r= -0.2561 respectively.
Conclusions: This study concludes that there is weak negative correlation between elbow and wrist flexor spasticity and hand function.

Key word: Stroke, Hand Function, Spasticity
Key message: The study concludes that spasticity does not affect hand function in stroke patients.

INTRODUCTION

Stroke is one of the major conditions which cause spasticity. [1] Prevalence of spasticity after stroke has been reported in 50% of subjects with stroke. [1,2] Spasticity is reported to develop within one month of an acute stroke. [3] Spasticity is best described as 'a motor disorder characterized by a velocity dependent increase in tonic stretch reflexes with exaggerated tendon jerks, resulting from hyper excitability of the stretch reflex. Hand function disability following stroke poses as one of the greatest obstacles to independent living thus leading to the need of proper assessment of hand function. Upper extremity recovery following stroke plays an important role on the functional independence. Upper extremity affection in terms of functional activities is one of the common problems faced by patients with stroke. Today, clinicians seek to treat the cause of the disability and that remains the core of the rehabilitation protocol. However, the rehabilitation regarding upper extremity is not homogenous among the practicing physiotherapists. There is a need of determining the factors affecting upper

extremity function in stroke patients.

Spasticity of upper limb muscles is common after stroke and increases as the duration of the stroke progresses. Several treatment techniques have incorporated the use of muscle tone reduction techniques to enhance motor function in patients with stroke. These techniques assume normal muscle tone as a prerequisite for optimal muscle function of hand. [4,5] Recent studies demonstrated that there is no correlation between lower limb muscle spasticity and gait parameters. [6,7]

There is no firm and concluding evidence regarding the relationship of upper limb spasticity and functional activities in stroke patients. There is conflicting evidence as to the different types of functional activities affected due to the spasticity of elbow or wrist flexors. Few studies have been conducted examining the effect of spasticity in lower limb muscles on gait. However, there are very few studies conducted, evaluating the relationship of upper extremity spasticity in upper extremity function directly. Information on this subject is important.

Aim of the study was to study the relationship between wrist flexor spasticity and hand function in patients with stroke.

METHODS

Cross-sectional study of individuals with stroke Physiotherapy OPD of D.V.V.P.F.'s College of Physiotherapy, Ahmednagar, India. This study is approved by the Institutional Ethic committee. 39 stroke patients with 6 weeks to 3 month post stroke duration entered the study. Inclusion criteria were 1) Males and females above 18 years 2) Single stroke- duration 3weeks to 6 months 3) Patients with wrist flexor spasticity 4) No history of anti-spastic treatment. Patients with severe contractures of hand, sensory impairments, medical co-morbidity (pain or fracture of the musculoskeletal system) were excluded from the study.

The wrist and elbow flexor spasticity was assessed in sitting position with back supported with elbow flexed 90 degrees.

Outcome measures:

Modified Tardieu Scale:

It is a scale use for measuring spasticity that takes into account resistance to passive movement at both fast and slow speed. There are 2 measurements: Quality of muscle reaction and angle of muscle reaction. Each muscle was tested once in two velocities (V1, V3). Firstly, in V1(Slowest possible speed), full passive range of motion of joint (R2) measured by the goniometer. In V3 (as fast as possible), the quality of muscle reaction was classified based on 0-5 grade, and if the catch or clonus appeared, the R1 (angle of catch or clonus appearance) was measured in the second movement of joint. Then, the angle of R2-R1 was recorded. Quality of muscle reaction was rated as follows:

• 0: No resistance throughout the course of the passive movement
• 1: Slight resistance through the course of passive movement; no clear ''catch'' at a precise angle
• 2: Clear catch at a precise angle, interrupting the passive movement, followed by release
• 3: Fatigable clonus (10s when maintaining the pressure) appearing at a precise angle
• 4: Unfatigable clonus (more than 10s when maintaining the pressure) at a precise angle
• 5: Joint is immovable

The reliability and validity of Modified Tardieu scale is well established. [8,9]

Action Research Arm Test:

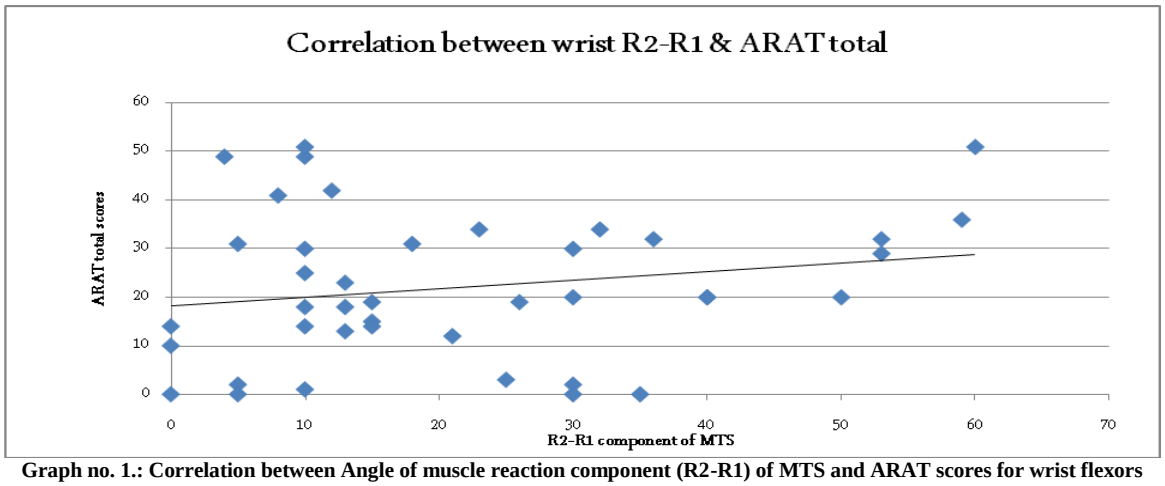
The test consists of 19 items grouped in 4 subtests (grasp, grip, pinch, and gross arm movement). The maximum possible score is 57 and minimum possible score is 0. The ARAT has shown high inter rater and intra rater reliability and validity. [10,11]

RESULTS

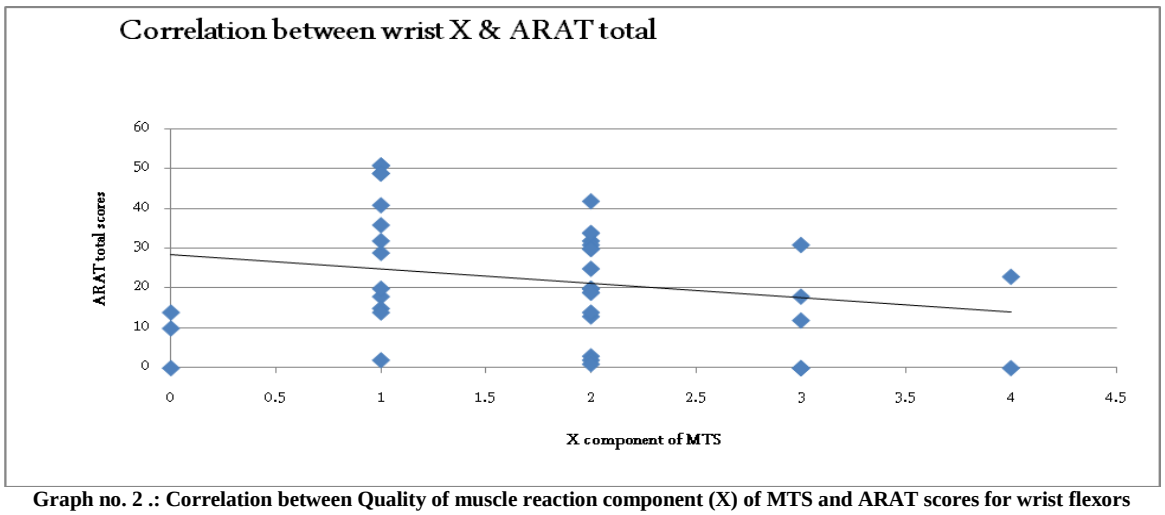
Data obtained was checked for normality by applying K-S test. Data shows normal distribution. Pearson's correlation co-efficient was used to correlate the scores of ARAT and angle of muscle reaction and quality of muscle reaction components of MTS for elbow and wrist flexors.

Table no. 1. : General characteristics of the subjects

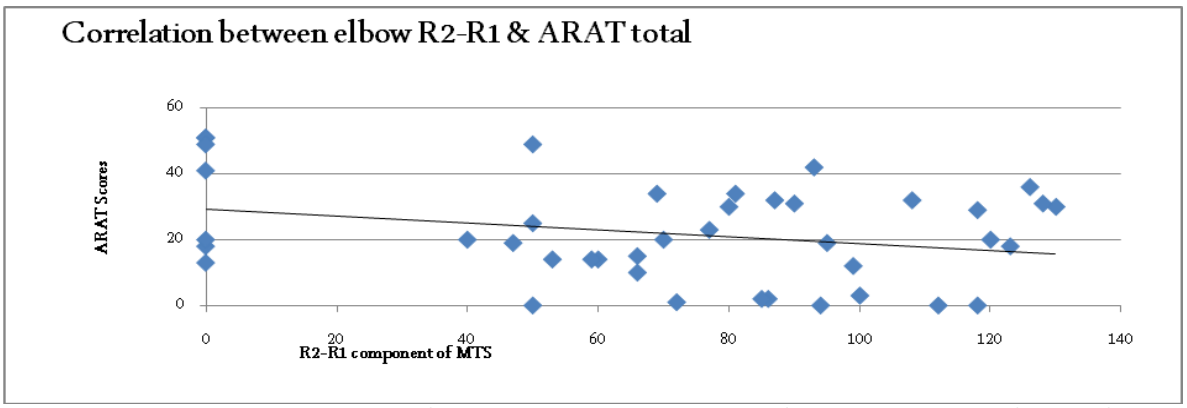
Variable	Mean	SD
Age (yrs)	54.58	14.625
Gender M:F (n)	28:11	
Dominance R:L(n)	36:3	
Affection R:L (n)	26:13	
Duration of stroke (days)	109.63	66.275
R2 - R1 Wrist flexors (degree)	21.56	16.778
X wrist flexors	1.75	0.94
R2 - R1 elbow flexors (degree)	70.78049	40.49
X elbow flexors	1.97561	1.255
ARAT Total scores	22.04	15.086



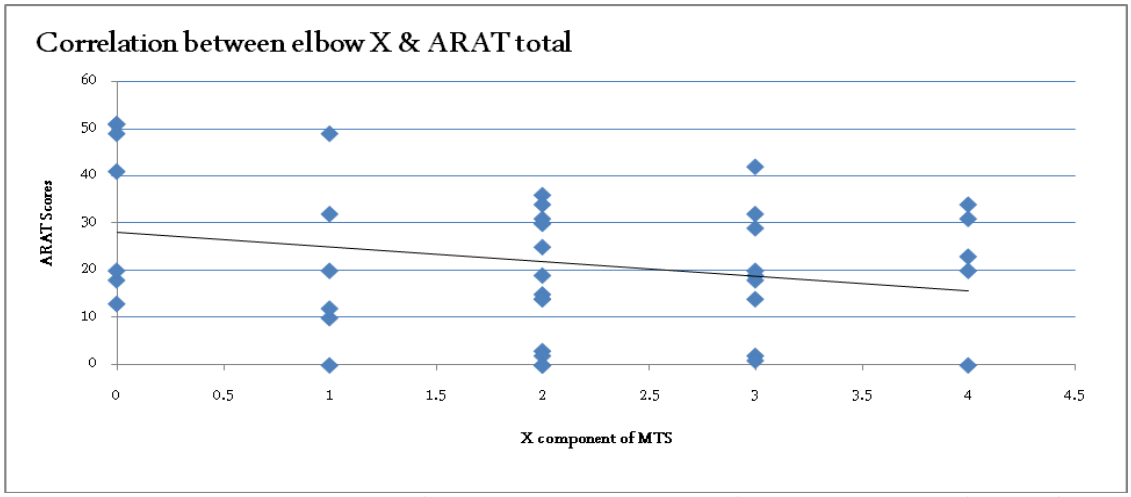
Graph no. 1.: Correlation between Angle of muscle reaction component (R2-R1) of MTS and ARAT scores for wrist flexors



Graph no. 2 .: Correlation between Quality of muscle reaction component (X) of MTS and ARAT scores for wrist flexors



Graph no. 3.: Correlation between Quality of muscle reaction component (R2-R1) of MTS and ARAT scores for elbow flexors



Graph no. 4 : Correlation between Quality of muscle reaction component (X) of MTS and ARAT scores for elbow flexors

Correlation between the angle of muscle reaction component (R2-R1) of MTS and ARAT scores for wrist flexors is weak and positive i.e. r= 0.1957. Correlation between the quality of muscle reaction component (X) of MTS and ARAT scores for wrist flexors is weak and positive i.e. r=-0.224.

Correlation between the angle of muscle reaction component (R2-R1) of MTS and ARAT scores for elbow flexors is weak and negative i.e. r= -0.2775. Correlation between the quality of muscle reaction component (X) of MTS and ARAT scores for elbow flexors is weak and negative i.e. r= -0.2561.

Most number of patients was rated as '2' on muscle reaction component of MTS for both, wrist and elbow flexors as seen in Table no. 2. The grade 2 on MTS is "catch at precise angle, interrupting the passive movement, followed by release," which not severe amount of spasticity as compared to grade 4 & 5 which are non-fatigable clonus (>10 seconds when maintaining pressure occurring at precise angle) & respectively.

The mean ARAT score was 22.04 out of 57 which indicates that the patient had moderate function of hand as seen in Table no.1. The mean score of grip subscale of ARAT scale is 7.26 and for pinch subscale of ARAT is 6.21. The pinch subscale score is less than grip subscale. The mean gross motor component subscale score of ARAT is 3.78 which is low.

DISCUSSION

This study is the first research that used Modified Tardieu Scale as a clinical measure of spasticity for assessing the relation between spasticity and hand function. The results of the study are in line with the previous studies which support the fact that spasticity does not affect the motor function.

A large difference between R2 – R1 middle and outer range shows that there is dynamic component in spasticity and small difference shows that there is a chance of fixed contracture in the muscle. The mean R2- R1 component for wrist flexors is 21.56 degrees and for elbow flexors is 70.78049 degrees respectively, as seen in Table no. 1. Thus, there is presence of dynamic spasticity in both wrist and elbow flexors. The spasticity of the patients of this study was not severe. This maybe one of the reasons why ARAT score was not correlated with spasticity. [12]

The study population includes stroke patients with a duration of 3.5 weeks and the spasticity recorded in this duration is low as seen in the table. Presence of spasticity at 4 weeks after stroke was a significant predictor only for severe spasticity at 12 months after stroke. As the tonic stretch reflexes increase during the first 3 months, intrinsic changes in the

muscle may occur as the time progresses. Therefore, presence of spasticity is an unreliable impairment during the first months. A recent study in stroke patients supported this finding, as it has been found that spasticity appeared during initial months post-stroke. Thus, assessing spasticity and its relation with hand function in sub-acute cases is necessary. [13]

Spasticity is a feature commonly seen in hemiparetic patients and it is commonly believed that spasticity influences motor performance. However, this study demonstrates that spasticity is very weakly correlated with hand function. Odwyer and coworkers found out that spasticity does not affect motor performance assessed as any task, self care activities or hand function test. [14] Spaulding et al, assessed the effect of wrist flexor spasticity on self-care activities. The results of their study agree with the results of our study. [15]

Studies conducted in lower extremity have also concluded that spasticity in muscles such as plantarflexors and knee extensor does not affect gait parameters. [6, 7] Study conducted by shah 1971 demonstrated results contradicting the results of this study. However, the author assessed spasticity as just a resistance to passive movement. [16] Modified tardieu scale is a more objective and reliable tool of assessing spasticity. [8,9]

The mean gross motor component subscale score of ARAT is 3.78 which is low. Gross motor subscale has components like "Put your hand above your head", which involve the use of proximal joints. Since the score is low, it may indicate impairment of proximal joints along with wrist. Paulignan, et al, 1990 studied the relation between coupling of proximal and distal parts during prehension. Kinematic analysis of movement was performed. The results indicated that there is coupling occurring between proximal segments i.e. shoulder and elbow and distal segments i.e. wrist. [17]

The mean ARAT score was 22.04 out of 57 which indicates that the patient had moderate function of hand as seen in Table no. 1. In a study conducted by Alvarez et al, various types of grasp strategies used by stroke patients have been studied. The strategies have been correlated with the components of Action Research Arm Test. The study concludes that subjects with a low ARAT score use grasp strategies more because of the impairments. The subjects with high ARAT scores use grasping strategies more similar to normal individuals. [18]

Some limitations maybe noted in the study. First, tone was assessed only at wrist and elbow flexors. It is possible that muscle tone abnormalities in other parts, particularly rest of upper extremity and trunk musculature may affect hand function. Second, it is possible that patients had abnormal muscle patterns that would not be evident during analysis but may interfere with performance.

Further analysis is required to predict value of muscle tone and relationship between muscle tone and function. Future studies with larger sample size and population with different stroke durations may be included. Muscle tone or spasticity as the principal cause of function impairment is a univariate approach. Recent findings indicate that strength, perception, should also be considered in analysis of factors affecting motor function.

CONCLUSION

This study concludes that there is weak negative correlation between elbow and wrist flexor spasticity and hand function. Spasticity for sub-acute patient group was mild to moderate in elbow and wrist flexors.

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