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Relationship Between Wrist Extension and Grip Strength Among Stroke Population: A Cross Sectional Study.

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ABSTRACT

Background: Stroke significantly impairs the upper extremities, with common deficits including muscle weakness and restricted wrist movement. Wrist extension loss has an impact on everyday activities and quality of life. For the performance of ADLs and upper limb function, grip strength is essential. For grasp control, the human hand's grip tolerance is crucial. Dynamometers are tools for forecasting outcomes and measuring grip strength. Effective rehabilitation treatments require a thorough understanding of grip strength and wrist motor control. This study aimed to assess the relationship between wrist extension and grip strength among stroke patients.

METHOD: A cross sectional study of 30 stroke patients from neurorehabilitation physiotherapy unit, Srinivas institute, Srinivas college Mukka, rehabilitation centres around Mangalore. We measured range of motion and grip strength using a goniometer and hand -held dynamometer.

RESULT: Positive correlations found between right wrist extension and grip strength ($r = 0.689$) and left wrist extension and grip strength ($r = 0.868$) in a study with 30 participants from Srinivas College of Physiotherapy's Neurorehabilitation department.

CONCLUSION: This study shown that there is a moderate positive correlation between wrist extension and grip strength in stroke patients. This study has limited by a relatively small sample size among participants. For future studies more sample might offer a better comprehensive view of the connection between wrist extension and grip strength in stroke patients.

KEYWORDS: Hand held dynamometer, goniometer, stroke patients.

INTRODUCTION

Stroke is an important contributor to long-term disability in the adult population worldwide. A stroke impacts the upper extremities in around half of those who have it and these deficits include synergistic movements, reduced somatosensorial spasticity, muscular weakness. In the upper extremities, muscular weakness is the most prevalent disability.[1] Stroke affects many joints in the arm, resulting in stereotyped patterns of arm deformity involving the shoulder, elbow, wrist and hand, as well as disturbed synchronisation of numerous joints in active movements.[2] In chronic stroke, impaired wrist movement is prevalent. The movements of the wrist and forearm joints must be coordinated for daily tasks. In instance, wrist extension is necessary to put the hand and fingers in a functional position for grasping and manipulating objects during work-related and leisure activities.[3] A velocity-dependent increase in muscle tone is a symptom of spasticity, a disorder of the excessive stretch reflex. Damage to the upper motor neurons causes higher motor neuron syndrome.[4]

An essential part of the hand contacting movement is wrist extension. In clinical practise, severe wrist paralysis is a significant issue. This affects the patient’s ability to do their everyday tasks and their quality of life.[5] The hand is a remarkable and versatile part of the human body, playing a crucial role in various functions in everyday life. Its diversity of functions allows us to perform a wide range of tasks, contributing to our independence, quality of life and overall functionality. Loss of independence in upper limb function can significantly impact daily activities, both basic and instrumental and diminish our ability to lead an independent and fulfilling life. The hand serves a dual purpose, enabling us to carry out fundamental activities in our daily lives, such as gripping, holding and manipulating objects. Additionally, it empowers us to engage in intricate tasks that demand refined motor skills, including writing, typing, playing musical instruments, and creating artwork.[6] We rely largely on the functionality of our hands in our daily lives. It takes fine motor skills to hold, grip, and manipulate objects. They require the interaction of several sensorimotor systems. Visual, tactile, auditory and sensory input must be combined with sensorimotor predictions based on mechanical features of the objects being manipulated such as weight and surface. Reactive adaptations to shifting loads are also significant[7]. After a stroke, individuals have a complicated pattern of upper extremity motor deficits that lead to the loss of useful skills such as grip and grasp.[8] According to numerous studies, grip strength is essential for upper limb function in both the whole palm and the fingers and is highly associated with motor function and ADL performance.[9]

Humans can successfully grip a variety of items in a variety of acceptable relative positions between the human hand and the object. This grab feature is known as the grip tolerance of the human hand and it is an important functionality of the human grasp. To fully comprehend the motor control of the human hand, an examination of hand and wrist postural synergy in tolerance gripping of diverse objects is required.[10] The dynamometer was widely used by neurologists in the late nineteenth century. Various dynamometers were created and used by neurologists at the time to test muscular strength, following the broader trend of using apparatus to differentiate our profession and facilitate observation and diagnosis. [11] Hand-grip strength, which can be easily and objectively evaluated using a dynamometer, predicts many outcomes in a range of subjects. [12]

Michal Starosta et al. conducted a study in year of 2017which aims to determine the muscles with the lowest strength in non-affected (non-A) and affected upper limb(A), to assess differences between men and women and to correlate these values with age in patients after stroke. dynamometer. They calculated the coefficients of correlation for muscular force differences compared the Rivermead Motor Assessment (RMA) arm segment. According to the findings of this investigation, the strength of the affected upper limb was 39% lower than that of the non-affected.[13] Elisabeth Ekstrand et al. conducted a cross-sectional study in the year of 2016 to look into the relationship between grip strength and isometric and isokinetic arm muscle strength in people who have had a stroke. Participants were 45 people who had mild-to-moderate upper extremity paresis at least 6 months after a stroke. This cross-sectional study discovered that grip strength is substantially related to arm muscular strength in people in the chronic phase of stroke recovery. Because grip strength is easier to measure and takes less time than arm muscle strength assessments, it implies that grip strength can be a typical measure of upper extremity muscular weakness in chronic phase after stroke. [14]

METHDOLOGY

This cross-sectional type of study aimed to established the relationship between wrist extension and grip strength among stroke patients. The ethical clearance obtained at the university level ethical board, at Srinivas university. A group of 30 participants were sort out for the study, aged above 30. The project was conducted at Srinivas institute of physiotherapy over a duration of 6 months from January to June in the year 2023.

Patient suffering from subacute and chronic stroke with the inclusion criteria of both the gender, aged above 30 years were included and the set exclusion criteria of patients with any musculoskeletal surgeries involving the upper extremity and any other neurological condition. The research was done between January 2023 to July 2023, each sample provided their written, informed consent.

PROCEDURE

Following receiving the institutional ethical board approval in terms of ethics, the sample collection commenced. Participants are screened based on inclusion and exclusion criteria after providing written informed permission.

Procedure was included pre assessment information included a synopsis of the research and testing protocol. After gathering demographic information, measuring wrist extension by goniometer and grip strength by hand held dynamometer.

All the participants were collected using the inclusion and exclusion criteria. Patients were asked to read and sign the consent form before participating in the study. This study aims to investigate the relationship between wrist extension and hand function among stroke patients. In total 30 subjects will be taken and their wrist extension checked using a goniometer and hand function checked by a hand-held dynamometer. For wrist extension, ask the subject to take an armchair and sit comfortably. Identify the relevant anatomical landmarks on the patient's wrist. The landmarks for measuring wrist extension are usually the styloid process of the ulna (located on the lateral side of the wrist towards the little finger) and the dorsum of the hand (the back of the hand). Place the goniometer's moving arm over the fifth metacarpal bone, which is near the little finger, and the fixed arm over the ulnar styloid process on the dorsum of the hand. In order to avoid any unwanted movement during the measurement, stabilise the 6 forearm and make sure that the patient's forearm is stabilised against a surface or held by a helper. The patient should be asked to extend their wrist as much as they can 4 without feeling any pain or discomfort. While the patient maintains the wrist extension, read the angle indicated by the goniometer. The angle between the stationary and movable arms represents the degree of wrist extension. And record the measurement. For grip strength, the participant is sat straight; their elbow is flexed at 90° and their forearm is in a neutral posture. Give the participant specific instructions on how to conduct the grip strength test as well as an explanation of the method, the test's goal and how to conduct it. Adjust the dynamometer and set the handle size of the dynamometer according to the participant's hand size. Ensure that the participant's second to fifth fingers can comfortably grip the handle. Ask the participant to hold the dynamometer in their testing hand with their arm resting on a flat surface such as a table and the dynamometer aligned with their forearm. Instruct the participant to squeeze the dynamometer handle as hard as they must use all their fingers for a maximum isometric effort. Their fingers should be 8 properly positioned on the handle and the thumb is not exerting any force. Perform thrice trials to ensure accurate results. It is recommended to conduct at least three trials on each hand, allowing the participant to rest for a brief period between each trial. For each trial, record the maximum reading. Calculate the average of the three or more trials to determine the participant's grip strength. To evaluate the opposite hand's grip strength, repeat the entire procedure with the participant's other hand. Record the participant's grip strength measurements as well as any important information such as age, gender and hand dominance.

STATISTICAL ANALYSIS

Descriptive statistical analysis was carried out for demographic characteristics and individual parameters, used in SPSS software for statistical analysis. Given the data was discovered to be not normally distributed the Pearson test and Spearman’s test, median standard deviation nonparametric and parametric, Interquartile range test was performed.

RESULT

40 screening form were distributed throughout the department of neurorehabilitation, Srinivas college of physiotherapy campus and the inclusion and exclusion criteria were used to make the selection. The study involved 30 participants. Table.1 Parametric correlation (Pearson). This table shows the correlation coefficient between affected side of right wrist extension and grip strength. The correlation coefficient of r value is 0.689. Table.2 Non parametric (Spearman’s rho). It shows the correlation coefficient between affected side of left wrist extension and grip strength suggested positive relationship with the r value of 0.868

		Grip Strength -Rt	Grip Strength -Lt	Wrist Extension -Rt	Wrist Extension -Lt	Affected Rt-Side
Grip Strength -Rt	Pearson Correlation	1	-.461*	.689**	-.716**	.c
	Sig. (2-tailed)		.023	.000	.000	.
	N	24	24	24	24	24
Grip Strength -Lt	Pearson Correlation	-.461*	1	-.041	.804**	.c
	Sig. (2-tailed)	.023		.849	.000	.
	N	24	24	24	24	24
Wrist Extension-Rt	Pearson Correlation	.689**	-.041	1	-.338	.c
	Sig. (2-tailed)	.000	.849		.106	.
	N	24	24	24	24	24
Wrist Extension-Lt	Pearson Correlation	-.716**	.804**	-.338	1	.c
	Sig. (2-tailed)	.000	.000	.106		.
	N	24	24	24	24	24
Affected Rt-Side	Pearson Correlation	.c	.c	.c	.c	.c
	Sig. (2-tailed)	.	.	.	.	
	N	24	24	24	24	24

Table 1: Pearson’s correlation (right side)

		GRIP STRNGTH RIGHT	GRIP STRNGTH LEFT	WRIST EXTENSION RIGHT	WRIST EXTENSION LEFT	AFFECTED SIDE
Grip strength right	Correlation coefficient	1.000	-.031	.250	.031	
	Sig. (2-tailed)	.	.954	.633	.954	
	N	6	6	6	6	6
Grip strength left	Correlation coefficient	-.031	1.000	-.836*	.868*	
	Sig. (2-tailed)	.954	.	.038	.025	
	N	6	6	6	6	6
Wrist extension right	Correlation coefficient	.250	-.836*	1.000	-.806	
	Sig. (2-tailed)	.633	.038	.	.053	
	N	6	6	6	6	6
Wrist extension left	Correlation coefficient	.031	.868*	-.806	1.000	
	Sig. (2-tailed)	.954	.025	.053	.	
	N	6	6	6	6	6
Affected side	Correlation coefficient	.	.	.	.	
	Sig. (2-tailed)	.	.	.	.	
	N	6	6	6	6	6

Table 2: Spearman's correlation (left side)

DISCUSSION

The purpose of this study was to investigate how grip strength and wrist extension were related in stroke patients. A sample of 30 stroke patients with subacute and chronic conditions were recruited, adhering to specific inclusion and exclusion criteria. A goniometer was used to measure wrist extension and a dynamometer were used to evaluate grip power. Statistical analysis, including correlation tests, was used to examine the data. The results provided insights into the association between wrist extension and grip strength among stroke patients. The results could influence stroke rehabilitation by directing the creation of focused interventions to improve hand function. In stroke patients, wrist extension biomechanics can be significantly affected because of the neurological damage caused by the stroke. Stroke often leads to motor impairments, including weakness, spasticity and reduced coordination, which can directly impact wrist extension movements. Muscular adaptation and biomechanics may also contribute to the observed correlation between wrist extension and grip strength. Impairments in wrist extension can lead to weakness in the extensor muscle, which are vital for gripping actions. By targeting wrist extension exercises during rehabilitation, therapist may indirectly strengthen the muscle necessary for gripping, leading to improved grip strength relies on the coordinated activation of multiple muscle in the forearm and hand. Restoring proper wrist extension could positively impact the muscle synergy, facilitating more effective grip performance. According to the results of this study, there is an important beneficial association between grip strength and wrist extension in stroke patients. This conclusion suggests that increasing wrist extension may increase grip strength. Wrist exercise should be integrated into stroke rehabilitation programme to promote functional recovery and enhance the patient's ability to perform daily task. Wrist extension and grip strength are closely related biomechanically, as they both involve the activation of muscles in the forearm and hand. Wrist extension is the motion that allows the hand to move upward relative to the forearm, while grip strength is the force generated by the hand when grasping objects. During grip task, the wrist plays a crucial role in maintaining stability and providing a firm base for the fingers to exert force on an object. Passive and active insufficiency refer, to the limitations of muscles ability to lengthen on contact, respectively and can have implications for grip strength in stroke survivors. Passive insufficiency occurs when a muscles length is insufficient to allows full joint range of motion. In the context of grip strength, passive insufficiency may affect the ability of certain muscle to adequately elongate during wrist extension or grip tasks. In stroke patients' passive insufficiency can be particularly relevant due to the presence of muscle tightness or contracture resulting from spasticity or prolonged immobilization. In the case of wrist extension, passive insufficiency of the wrist extensor muscle could limit the extension range, making it challenging for stroke patients to fully extend their wrist during grip task. this restriction may hinder the ability to achieve on optimal grip restriction and generate sufficient force during grasping movements. Active insufficiency occurs when a muscles ability to contract is limited due to its shortened positions. In the context of grip strength, active insufficiency may affect the strength and force generating capacity of the muscle involved in gripping actions. In stroke patients, muscle weakness is a common consequence of motor impairments and this weakness can lead to active insufficiency during grip tasks. In the context of grip strength, active insufficiency of the wrist extensor muscles may result in reduced force generations during gripping actions. Weakened wrist extensors may struggle to generate sufficient force to maintain a strong and sustained grip on object, impacting functional tasks that require gripping. Passive and active insufficiency are important consideration in understanding grip strength limitation in stroke patients. Passive insufficiency may restrict wrist extension range, while active insufficiency may lead to weakened grip strength due to muscle weakness. By addressing both aspects of insufficiency through targeted strengthen and stretching exercises, therapist can improve wrist extension and grip strength in stroke survivors, ultimately enhancing their functional abilities and quality of life. Total 40 participants were screened, out of which 30 were selected. The sample included 24 males and 6 females. 24 stroke patients are affected on their right side, while 6 are affected in left side. This study established a clear positive association between wrist extension and grip strength in stroke patients.

CONCLUSION

This study shown that there is a moderate positive correlation between wrist extension and grip strength in stroke patients. This study has limited by a relatively small sample size among participants. For future studies more sample might offer a better comprehensive view of the connection between wrist extension and grip strength in stroke patients.

CONFLICTS OF INTERESTS

There are no reported conflicts of interests.

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REFERENCES

1. Ekstrand, E., Lexell, J., & Brogårdh, C. (2016). Grip strength is a representative measure of muscle weakness in the upper extremity after stroke. Topics in stroke rehabilitation, 23(6), 400–405. https://doi.org/10.1080/10749357.2016.1168591
2. Zhang, L. Q., Son, J., Park, H. S., Kang, S. H., Lee, Y., & Ren, Y. (2017). Changes of Shoulder, Elbow, and Wrist Stiffness Matrix Post Stroke. IEEE transactions on neural systems and rehabilitation engineering: a publication of the IEEE Engineering in Medicine and Biology Society, 25(7), 844–851. https://doi.org/10.1109/TNSRE.2017.2707238
3. Ravindran, A., Rieke, J. D., Zapata, J. D. A., White, K. D., Matarasso, A., Yusufali, M. M., Rana, M., Gunduz, A., Modarres, M., Sitaram, R., & Daly, J. J. (2021). Four methods of brain pattern analyses of fMRI signals associated with wrist extension versus wrist flexion studied for potential use in future motor learning BCI. PloS one, 16(8), e0254338. https://doi.org/10.1371/journal.pone.0254338
4. Trompetto, C., Marinelli, L., Mori, L., Pelosin, E., Currà, A., Molfetta, L., & Abbruzzese, G. (2014). Pathophysiology of spasticity: implications for neurorehabilitation. BioMed research international, 2014, 354906. https://doi.org/10.1155/2014/354906
5. Li, F., Jiang, L., Zhang, Y., Huang, D., Wei, X., Jiang, Y., Yao, D., Xu, P., & Li, H. (2022). The time-varying networks of the wrist extension in post-stroke hemiplegic patients. Cognitive neurodynamics, 16(4), 757–766. https://doi.org/10.1007/s11571-021-09738-2
6. Dovat, Ludovic Lambercy, Olivier Johnson, Vineet Salman, Berna Wong, Stephen Gassert, Roger Burdet, Etienne Leong, Teo Chee and Milner, Theodore 2007. A Cable Driven Robotic System to Train Finger Function After Stroke. p. 222.
7. Ostolaza, M., Abudarham, J., Dilascio, S., Drault-Boedo, E., Gallo, S., Garcete, A., Kramer, M., Maiaru, M., Mendelevich, A., Modica, M., Peralta, F., & Sanchez-Correa, C. (2017). Herramientas de evaluacion del uso fino de la mano y uso de la mano y el brazo en sujetos con secuela de ictus: revision sistematica [Hand fine motor skills and use of both hand and arm in subjects after a stroke: a systematic review]. Revista de neurologia, 64(7), 289–298.
8. Raghavan P. (2015). Upper Limb Motor Impairment After Stroke. Physical medicine and rehabilitation clinics of North America, 26(4), 599–610. https://doi.org/10.1016/j.pmr.2015.06.008
9. Kim D. (2016). The effects of hand strength on upper extremity function and activities of daily living in stroke patients, with a focus on right hemiplegia. Journal of physical therapy science, 28(9), 2565–2567. https://doi.org/10.1589/jpts.28.2565
10. Liu, Y., Zeng, B., Jiang, L., Liu, H., & Ming, D. (2021). Quantitative Investigation of Hand Grasp Functionality: Thumb Grasping Behaviour Adapting to Different Object Shapes, Sizes, and Relative Positions. Applied bionics and biomechanics, 2021, 2640422. https://doi.org/10.1155/2021/2640422

11. Mafi, P., Mafi, R., Hindocha, S., Griffin, M., & Khan, W. (2012). A systematic review of dynamometry and its role in hand trauma assessment. The open orthopaedics journal, 6, 95–102. https://doi.org/10.2174/1874325001206010095
12. Bohannon R. W. (2001). Dynamometer measurements of hand-grip strength predict multiple outcomes. Perceptual and motor skills, 93(2), 323–328. https://doi.org/10.2466/pms.2001.93.2.323
13. Starosta, M., Kostka, J., Redlicka, J., & Miller, E. (2017). Analysis of upper limb muscle strength in the early phase of brain stroke. *Acta of Bioengineering and Biomechanics*, *19*(3), 85-91.
14. Ekstrand, E., Lexell, J., & Brogårdh, C. (2016). Grip strength is a representative measure of muscle weakness in the upper extremity after stroke. *Topics in stroke rehabilitation*, *23*(6), 400-405.