

Can Brunnstrom Stages of Recovery of Hand Function Predict Functional Activities of Hand at 4 Weeks in Patients with Stroke- A Pilot Study

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ABSTRACT

Background: Hand recovery is one of the most important treatment goal for patients with stroke. A valid and reliable measure assessing post stroke hand function is essential for appropriate clinical decision and treatment planning. Therefore, the present study aimed to find out the predictive validity of Brunnstrom Stages of Recovery of hand function for functional activities measured by ICF Codes and Sollerman Hand Function test in patients with stroke.

Methodology: 10 individuals with stroke were recruited and assessed for baseline, after 2 weeks and score after 4 weeks for Brunnstrom stage of recovery for hand, ICF codes for hand and Sollerman hand function test.

Results: Brunnstrom stage of recovery for hand and ICF codes for hand function were found to have significant negative relation between them (Picking up: -0.95, Grasping: -0.88, Manipulating: -0.87, Releasing: -0.95) whereas there was a significant positive correlation of 0.93 between BRS hand and Sollerman hand function test.

Conclusion: The present study concluded that the Brunnstrom recovery stage for hand can predict the functional use of hand in patient at 4 weeks stroke.

KEYWORDS: Hand function, Prediction, Brunnstrom stage, ICF code, Sollerman hand function test.

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INTRODUCTION

“Rapidly developed clinical signs of focal (or global) cerebral function that persist for more than 24 hours or result in mortality, with no discernible cause other than vascular origin,” is how the World Health Organisation (WHO)

defines a cerebrovascular accident (CVA) or stroke [1]. Stroke ranks third in terms of disability and is the second leading cause of death [1,2]. Worldwide, one stroke will occur in the lifespan of every four adults over the age of 25. The elderly population in India is

estimated to be vulnerable, with 1.36 billion people as of 2019 and projected to increase by 20% by 2025 [3]. The Asian Stroke Advisory Panel reported that the annual incidence of stroke in Asia varied from 116 to 483/100,000 [4]. In India, the anticipated prevalence of stroke in 2020 was estimated to be between 26 757/100,000, with an average annual occurrence ratio ranging from 108 172/100,000 [5,6]. More than 50% stroke patients remain vocationally impaired and about 30% need full support for activities of daily living [7].

Deficits from strokes include those related to motor, sensory, perceptual, and verbal abilities. The most prominent variant is motor weakness or hemiparesis on the side of the body opposite the lesion, leading in disability [8]. Following a stroke, hand function is frequently compromised, which significantly impair ones capacity to carry out daily tasks [9].

In the chronic stage following a stroke, hand impairment is particularly common. It often presents as abnormal hand flexion synergy, which is characterized by a pattern of involuntary motor activation resulting in finger and hand flexion, as well as a decrease in finger strength and dexterity. [10].

Hand function is a major impairment seen in most of the patients with stroke. Hand recovery is one of the most important treatment goals for patients with stroke. A valid and reliable measure assessing post stroke hand function is essential for appropriate clinical decision and treatment planning. The Brunnstrom recovery stages is a short and easy administration measure for assessing hand function. It is a regular tool used to assess the level of recovery of hand motions. But there are very few evidences present correlating the Brunnstrom hand recovery stages with functional hand use. Therefore, the aim of the study was to predict the validity of Brunnstrom Stages of Recovery of hand function for functional activities measured by ICF Codes and Sollerman Hand Function test in patients with stroke.

METHODOLOGY

Participants: This study was approved by

local ethics committee. Informed consent was obtained directly or via a care-giver. Ten patients with stroke were recruited on the basis of set inclusion and exclusion criteria. 1) Patients with sub acute and chronic stroke, 2) Age between 20 to 60 yrs, 3) Both males and females, 4) Those with first ever stroke 5) Ischemic or Haemorrhagic type of stroke. 6) Patients with MMSE score > 24 were included in the study. Exclusion criteria was set as 1) Patients with any musculoskeletal problem related to wrist and hand (e.g. Recent fracture and sprain) or any cardiorespiratory condition. 2) Patients who are not willing to participate. 3) Patients undergoing other treatment for hand function (e.g. Acupuncture therapy and Antispasmodic medications) or received Botulinum toxin injections within 3 months. 4) Histories of other neurological diseases such as dementia and peripheral polyneuropathy.

Procedure: The information collected from the patient included the demographic data including age, gender, hand dominance along with stage and type of stroke and the side affected. The assessment was done on 3 time intervals i.e. baseline, after 2 weeks and after 4 weeks. All the measurements were performed by the same trained physiotherapist. Brunnstrom recovery stages for hand which describes six stages of the Stroke recovery process in hemiplegic patients. Interrater reliability excellent, with an intraclass correlation coefficient of 0.91 [11], ICF Codes for Hand and Sollerman Hand Function Test with high test-retest reliability, high Interrater reliability and high intrarater reliability were used to assess the hand function of the patient [12].

Statistical analysis:

Pearson Correlation coefficient was used to find the correlation between Brunnstrom Recovery Stage of Hand & ICF Codes for Hand whereas Spearman Correlation coefficient was used to find the correlation between Brunnstrom Recovery Stage of Hand & Sollerman Hand Function Test. The strength of correlations was interpreted as follows: low (0.00–0.39), moderate (0.40–0.59), moderately high (0.60–0.79), high (0.80–1.00).

RESULTS

Table 1: Demographic Data.

Characteristics	Mean ± SD	Percentage (Number)
Age	54.1 ± 10.73 years	-
Gender- Male	8	80%
Female	2	20%
Duration	26.7 ± 46.96 months	-
Stage- Subacute	4	40%
Chronic	6	60%
Type – Ischemic	7	70%
Hemorrhagic	3	30%
Affected side- Right	3	30%
Left	7	70%

Table 1 shows the demographic data of the patients included in the study. Ten right hand-dominant patients with hemiplegia after stroke (8 men and 2 women) and a mean (standard deviation, range) age of 54.1 years (10.73, 35–60) participated. The mean (standard deviation) time since the stroke onset was 26.7 (46.96) months. 4 patients were in sub-acute stage of stroke whereas 6 were the chronic stroke survivors. 3 were right hemiparetic and 7 were having left as the affected side of the stroke.

Table 2 shows the mean values of all the measurement tools at each time interval. The mean (SD) score for Brunnstrom Recovery Stage of Hand at baseline was found to be 3.8 (1.8) whereas for 2 weeks and 4 weeks was calculated to be 4.2 (1.6) and 4.4 (1.4) respectively. Similarly, for Sollerman Hand Function Test, the mean (SD) scores for baseline, after 2 weeks and after 4 weeks were found to be 38.9 (29.7), 41.9 (28.4) and 46.5 (24.9) respectively. Along with this, the mean scores for ICF Codes for hand function were also evaluated.

Table 3 shows Correlation between Brunnstrom recovery stage of Hand and ICF codes for Hand. It was found that there was a high (0.80–1.00) negative correlation between all the ICF codes for hand function and Brunnstrom Recovery Stage of Hand at all the time periods except the grasping activity with assessment after 2 weeks showing moderately high (0.60–0.79) negative correlation. The correlation between Brunnstrom recovery stage of Hand and Sollerman Hand Function Test was found to be high at each time interval (Tab.4).

Table 2: Mean and Standard deviation (SD) of Outcome Measures.

Measurement tools	Mean± SD			
	Baseline	After 2 weeks	After 4 weeks	
Brunnstrom Recovery Stage of Hand	3.8±1.8	4.2±1.6	4.4±1.4	
ICF Codes:	d4400 Picking up	2± 1.4	2±1.4	1.8±1.4
	d4401Grasping	1.8±1.2	1.7±1.2	1.6±1.3
	d4402Manipulating	2.5±1.2	2.5±1.2	2.2±1.1
	d4403Releasing	1.9±1.6	1.9±1.6	1.6±1.5
Sollerman Hand Function Test	38.9±29.7	41.9±28.4	46.5±24.9	

Table 3: Correlation between Brunnstrom recovery stage of Hand & ICF codes for Hand and Sollerman Hand Function Test.

Independent Variable	Dependent Variable	r value		
		Baseline	After 2 weeks	After 4 weeks
Brunnstrom Recovery Stage of Hand	ICF Code: Picking up	-0.9	-0.82	-0.95
	Grasping	-0.81	-0.78	-0.88
	Manipulating	-0.86	-0.81	-0.87
	Releasing	-0.92	-0.85	-0.95
	Sollerman Hand Function Test	0.84	0.85	0.93

Table 4: Correlation between Brunnstrom recovery stage of Hand & Sollerman Hand Function Test

Independent Variable	Dependent Variable	r value		
		Baseline	After 2 weeks	After 4 weeks
Brunnstrom Recovery Stage of Hand	Sollerman Hand Function Test	0.84	0.85	0.93

DISCUSSION

The present study suggests that there is a high correlation between Brunnstrom recovery stages of hand with ICF codes for hand function as well as Sollerman hand function test. Therefore, Brunnstrom recovery stages of hand have a good predictive validity for functional use of the hand in sub- acute and chronic stroke patients.

Soofia Naghdi conducted a neurophysiological and clinical study of Brunnstrom recovery stages in the upper limb following stroke, concluding that the Brunnstrom recovery stages are moderately correlated with neurophysiological measures and highly correlated with the MMAS for evaluating motor recovery in stroke patients. The Brunnstrom recovery phases are a viable test for assessing people with post stroke hemiplegia [13].

Ismail Safaz et al. conducted a research to determine whether Brunnstrom recovery stage (BRS) and motricity index (MI) were connected, and whether the two evaluation methods were sensitive to changes in rehabilitation result. The study indicated that both upper extremity (UE) and hand BRS scores were favourably linked with those of UE-MI; moreover, correlations between discharge values were larger than those between admission values [14].

A paper was published providing an objective technique of evaluating hand motion quality utilizing an optical motion capture technology paired with Brunnstrom criteria, an extensively used assessment scale in clinics. The findings confirmed the method's capacity to assess the quality of human hand motion, which has the potential for rehabilitation evaluation of stroke patients' hand motion and to serve as the foundation for the development of rehabilitation training programs [15].

Kazuaki Iokawa et al. undertook a cross-sectional research to determine the functional

and cognitive characteristics that predict successful use of chopsticks or a spoon by patients with paretic upper extremities after stroke. It was determined that the interplay of the UE Brunnstrom recovery stage as a measure of UE function and the Hasegawa Dementia Scale - Revised score as a measure of cognitive function influences the capacity of stroke patients to functionally use the paretic UE to operate chopsticks or a spoon [16].

Yumi Suzuki et al. conducted a retrospective cohort study and discovered that the BRS Hand and FIM Eating and Grooming domains of the Functional Independence Measure were predictive factors for prognosis from the status of early motor paralysis and ADL in patients with acute middle cerebral artery (MCA) infarctions [17].

Long Meng et al. did a study to investigate the possibility of automatically assessing the upper-limb Brunnstrom Recovery Stage (BRS) using three common ADLs (toothbrushing, face washing, and drinking). They concluded that the proposed technique may be utilized as a factor-screening tool for automatic BRS 33 categorization and shows promise for future application at home [18].

Bhalerao Gajanan et al conducted a study to determine the correlation of voluntary control (Brunnstrom stages of recovery) with ADLs and motor function in stroke patients and concluded that voluntary control (Brunnstrom stages of recovery) has a poor correlation with motor function and activities of daily living [19].

AUTHOR'S CONTRIBUTION

Anuja Rajurkar: Conceptualization/Investigation/ Resources/Writing– original draft. **Maheshwari Harishchandre:** Conceptualization/ Methodology/ Data curation/ Supervision/ Validation/ Writing original draft. **Suvarna Ganvir:** Project administration/ Methodology/ Supervision/Writing– original draft.

CONCLUSION

The present study concluded that the Brunnstrom recovery stage for hand can predict the functional use of hand in patient with sub- acute and chronic stroke.

ABBREVIATIONS

ICF- International Classification of Function, Disability and Health

WHO- World Health Organization

CVA- Cerebrovascular Accident

SD- Standard Deviation

BRS- Brunnstrom Recovery Stage

MI- Motricity Index

UE- Upper Extremity

FIM- Functional Independence Measure

MCA- Middle Cerebral Artery

ADL- Activities of Daily Living

Conflicts of Interest: There are no conflicts of interest.

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